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PCT/FI00/00657

# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

## PCT

### NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

**Date of mailing** (day/month/year)
08 January 2002 (08.01.02)

**Applicant's or agent's file reference**
BP100021

**IMPORTANT NOTIFICATION**

**International application No.**
PCT/FI00/00657

**International filing date** (day/month/year)
21 July 2000 (21.07.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
NOKIA NETWORKS OY
P.O. Box 300
FIN-00045 Nokia Group
Finland

State of Nationality: FI
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
NOKIA CORPORATION
Keilalahdentie 4
FIN-02150 Espoo
Finland

State of Nationality: FI
State of Residence: FI
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

**The International Bureau of WIPO**
**34, chemin des Colombettes**
**1211 Geneva 20, Switzerland**

Facsimile No.: (41-22) 740.14.35

Authorized officer
Marie-José DEVILLARD

Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994)

004575720

# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

## PCT

### NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

| | |
|---|---|
| **Date of mailing** (day/month/year)<br>08 May 2001 (08.05.01) | |
| **International application No.**<br>PCT/FI00/00657 | **Applicant's or agent's file reference**<br>BP100021 |
| **International filing date** (day/month/year)<br>21 July 2000 (21.07.00) | **Priority date** (day/month/year)<br>23 July 1999 (23.07.99) |
| **Applicant**<br>SUONVIERI, Jukka et al | |

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

20 February 2001 (20.02.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

| | |
|---|---|
| **The International Bureau of WIPO**<br>**34, chemin des Colombettes**<br>**1211 Geneva 20, Switzerland** | Authorized officer<br>Claudio Borton |
| Facsimile No.: (41-22) 740.14.35 | Telephone No.: (41-22) 338.83.38 |

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00657

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/36, H04Q 7/30, H04B 7/26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | EP 0716555 A2 (NEC CORPORATION), 12 June 1996 (12.06.96), column 4, line 16 - column 7, line 48; column 16, line 48 - column 20, line 45, figures 1, 8,9,10, claims 1-19, abstract<br>-- | 1-6,12-15 |
| Y | US 5475869 A (MASATOSHI GOMI ET AL), 12 December 1995 (12.12.95), column 1, line 46 - column 3, line 3; column 3, line 62 - column 4, line 26; column 4, line 54 - column 7, line 1, figures 3,5, claims 1-7, abstract | 1-6,12-15 |
| A | -- | 7-11,16,17 |

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 22 December 2000 | 22 -12- 2000 |
| Name and mailing address of the ISA/<br>Swedish Patent Office<br>Box 5055, S-102 42 STOCKHOLM<br>Facsimile No. +46 8 666 02 86 | Authorized officer<br>Klas Arvidsson/mj<br>Telephone No. +46 8 782 25 00 |

Form PCT/ISA/210 (second sheet) (July 1998)

# PATENT COOPERATION TREATY

# PCT

REC'D 29 OCT 2001
WIPO PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| Applicant's or agent's file reference | FOR FURTHER ACTION | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| BP100021 | | |
| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
| PCT/FI00/00657 | 21/07/2000 | 23/07/1999 |
| International Patent Classification (IPC) or national classification and IPC<br>H04Q7/36 | | |
| Applicant<br>NOKIA NETWORKS OY et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☒ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 20/02/2001 | 25.10.2001 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized officer<br>Oteo Mayayo, C<br>Telephone No. +49 89 2399 7563 |

Form PCT/IPEA/409 (cover sheet) (January 1994)

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/FI00/00657

## I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
**Description, pages:**

| | | |
|---|---|---|
| 5-9 | as originally filed | |
| 1-4,4a | with telefax of | 17/09/2001 |

**Claims, No.:**

| | | |
|---|---|---|
| 1-17 | with telefax of | 17/09/2001 |

**Drawings, sheets:**

| | |
|---|---|
| 1/4-4/4 | as originally filed |

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   ☐ the language of publication of the international application (under Rule 48.3(b)).
   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.
   ☐ filed together with the international application in computer readable form.
   ☐ furnished subsequently to this Authority in written form.
   ☐ furnished subsequently to this Authority in computer readable form.
   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 1-17 |
| | No: | Claims | |
| Inventive step (IS) | Yes: | Claims | 1-11 |
| | No: | Claims | 12-17 |
| Industrial applicability (IA) | Yes: | Claims | 1-17 |
| | No: | Claims | |

2. Citations and explanations
   **see separate sheet**

## VI. Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

   **see separate sheet**

## VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
**see separate sheet**

## 1. Concerning Item I

**Basis of the opinion**

Reference is made to the following documents:

D1: EP-A2-0716555
D2: US-A-5475869

## 2. Concerning Item V

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

The present invention relates to a **method** for redetermining the operating frequencies of base stations of a first cellular radio network (internal network) implemented indoors (i.e. when the operating conditions of a first cellular radio network have changed) and to a corresponding **arrangement** for that redetermination of frequencies, according to independent **claims 1 and 12**.

2.1 In the method disclosed in the document cited in the International Search Report and considered as the closest prior art (D1: **EP 0716555, 12.06.1996**), the feature of "the redetermination of the operating frequencies being performed on the basis of information about a frequency plan of an external network, which is a second cellular radio network or part of a second cellular radio network detected in the area of the internal network, by examining if a frequency, which interferes with the base station of the internal network, has been taken into use in the external network" is not disclosed.

The problem solved by the present invention is regarded as how to use information about a frequency plan of an external network, for redetermining the operational frequencies of base stations of an internal network. The solution to said problem is that information about a frequency plan of an external network is used by examining if a frequency, which interferes with the base station of the internal network, has been taken into use in the external network .

The method according to claim 1 differs from that of D1 in that in D1 it is disclosed the use of frequency measurement performed for an earlier determination as well as storage of that measurement, but not the use of information about a frequency plan of an external network by examination of a frequency, which interferes with the base station of the internal network, to decide if it has been taken into use in the external network.

Therefore, the skilled person would not be prompted to derive a method according to independent **claim 1** from D1. Thus, claim 1 is considered to be **new** and to **involve an inventive step**, Articles 33 (2) and (3) PCT.

2.2 **Claims 2 to 11** are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

2.3 The document D1 is regarded as being the closest prior art to the subject-matter of **claim 12**, and insofar as this claim can be understood (see Section VIII), this document shows the following features thereof (the references in parentheses applying to this document):

(i) An arrangement for redetermining the operating frequencies (see D1, abstract: "... a base station repeats measuring ... and selects, based on such stored levels, an allocated channel for communication with a mobile station in the cell ...") of base stations of an internal network, which is a first cellular network or a part of a first cellular network implemented indoors or in an otherwise restricted area (see D1, abstract: "...This invention is applicable to channel reuse in a microcellular mobile communication system...") when the operating frequencies have been earlier determined by frequency measurement but the operating conditions of the internal network have changed (see D1, column 1, lines 31-38: "In compliance with the dynamic channel allocation the radio channels are not assigned to individual cells. Instead, the base station measures... and selects as the allocated channel one of the radio channels..."), characterised in that

(ii) it includes data processing means for the redetermination of the operating frequencies (see document D1, column 7, lines 2-7: "control means for calculating, in connection with each microcell base station, a channel count of free

channels...")

(iii) on the basis of a frequency measurement performed for an earlier determination (see D1, column 6, lines 15-19: "the control means selecting the allocated channel based on the stored level which includes the stored in response to the measured level measured additionally by the additional measuring means")

(iv) said data processing means including a database for saving the operating frequencies in use at the base stations of the external network (see document D1, column 6, lines 4-5: "storing means for storing the measured level as a stored level";).

The subject-matter of claim 12 differs from D1 only in that in D1 there is no explicit reference to "the redetermination of the operating frequencies is performed on the basis of the information of the external network" but it is only said that "regular measuring means for measuring an interference signal level of each radio channel" (D1, column 6, lines 1-3) are used, but those radio channels could belong as well to some of the base stations of the so-called internal network.

It is however generally known to the person skilled in the art, as well as disclosed in document D2 (which discloses a radio base station capable of distinguishing between interference due to collisions of outgoing call signals and an external interference noise, see D2, column 1, lines 45-49: "It is an object of this invention to provide a radio base station capable of distinguishing between interference due to collisions of outgoing call signals and an external interference noise"), that the feature of "being capable of distinguishing an external interference noise" is an equivalent to the feature "on the basis of the information of the external network" of document D1 and can be interchanged with that feature where circumstances make it desirable.

Thus, the subject-matter of **claim 12** lacks an inventive step and does not meet the requirements of Article 33(3) PCT.

2.4 **Dependent claims 13 to 17** do not contain any features which, in combination with the features of claim 12 to which they refer, meet the requirements of the

PCT in respect of inventive step in the sense of Article 33(3) PCT.

2.5 The present invention is **susceptible of industrial application**, Article 33 (4) PCT.

## 3. Concerning Item VI

**Certain documents cited**

Certain published documents (Rule 70.10)

| Application No Patent No | Publication date *(day/month/year)* | Filing date *(day/month/year)* | Priority date *(valid claim)* *(day/month/year)* |
|---|---|---|---|
| WO 00/01177 | 06.01.2000 | 29.06.1999 | 29.06.1998 |

Although this document (WO 00/01177) is not prior art according to Rule 64.1(a) PCT, it should be noticed that it discloses subject-matter which is considered to be relevant in respect of what is claimed in the present application.

## 4. Concerning Item VIII

**Certain observations on the international application**

The application does not meet the requirements of Article 6 PCT, because **independent claims 1 and 12** are not clear for the following reasons:

4.1 **Independent claims 1 and 12** are not clear since it is unclear what is meant by "implemented indoors or in an otherwise restricted area ...". As all cellular radio networks are implemented in a restricted area (there is no infinite cellular radio network), then these terms are vague and too broad and leave the reader in doubt regarding the definition of "internal network".

4.2 Furthermore, independent **claim 12** is also unclear because the claim is referring to the result to be achieved ("the redetermination ... is performed on the basis of a frequency measurement ... and the information of the external

network"), but it is not disclosed how to arrive at that result and, therefore, the skilled person would not know how to choose the appropriate way of implementing said arrangement in claim 12.

**Claims**

1. A method for redetermining the operating frequencies of base stations of an internal network when the operating conditions of the internal network have changed, **characterized** in that the redetermination of the operating frequencies is performed on the basis of a frequency measurement performed for an earlier determination and the information of the external network.

2. A method according to Claim 1, **characterized** in that it includes the following steps:

- saving (1) the results of an earlier measurement,

- examining (3-5) if a frequency which interferes with the base station of the internal network has been taken into use in the external network, and

if an interfering frequency is detected (3-5), changing (6) an interference-free frequency to the base station of the internal network on the basis of an earlier measurement and the frequencies of the external network.

3. A method according to Claim 1, **characterized** in that of the results of the earlier measurement, at least the frequency and the interference level and the identification information of that base station of the external network, which produces the interfering transmission, are saved (1) for the base stations of the internal network.

4. A method according to Claim 1, **characterized** in that when it is noticed that a base station recognized on the basis of an earlier measurement receives (9) in the new frequency plan a frequency already being used in a base station of the internal network, the frequency of the internal network is changed (6) to an interference-free frequency.

5. A method according to Claim 1, **characterized** in that when it is noticed that a base station recognized on the basis of an earlier measurement receives (9) in the new frequency plan a frequency which interferes with a frequency already being used in a base station of the internal network, the frequency of the base station of the internal network is changed (6) to an interference-free frequency.

6. A method according to Claim 1, **characterized** in that when it is detected (11) from the frequency plan that a frequency that was used by the external network and found to be affected by interference in an earlier measurement has become

Replaced by Article 34

interference-free because it is not used any more, this frequency is taken into use by the internal network.

7. A method according to Claim 1, **characterized** in that it also includes the following steps for checking the suitability of the frequency to be taken into use:

- measuring (22) the signal strength (Rx Level) received in the area of the internal network in the measurement route when the base station of the internal network transmits a signal on the broadcast control channel (BCCH),

- examining (23) if a certain predetermined proportion of the measurement samples of the signal strength is higher than a minimum value set in advance.

8. A method according to Claim 7, **characterized** in that the C/I ratio is calculated (25) by using the measured samples of the signal strength (Rx Level) of the broadcast control channel (BCCH) and the interference measurement performed on the frequencies to be compared.

9. A method according to Claim 8, **characterized** in that

- it is examined (26) if the C/I ratio is better than a certain predetermined minimum value in all the samples, and

- the frequency is accepted (30) if the signal strength is sufficient and the C/I ratio is better than a certain limit.

10. A method according to Claim 7, **characterized** in that in addition, to prevent the crosstalk of an adjacent channel, a measurement and examination (28) for accepting (30) the frequency is performed.

11. A method according to Claim 10, **characterized** in that the strength of both adjacent channels is at the most by a certain predetermined maximum value higher than the signal strength of the channel being considered.

12. An arrangement for redetermining the operating frequencies of base stations of an internal network, which have been earlier determined by frequency measurement, when the operating conditions of the internal network have changed, **characterized** in that it includes data processing means (13, 14, 15, 16, 17) for the redetermination of the operating frequencies on the basis of a frequency measurement performed for an earlier determination and the information of the external network.

13. An arrangement according to Claim 12, **characterized** in that it includes

- a first database (16) for saving the information of a measurement performed earlier,

- a second database (17) for saving the operating frequencies of base stations of the external network, and

- a processor (13) for the redetermination of the operating frequencies of base stations of the internal network carried out on the basis of the information of the first database and the second database.

14. An arrangement according to Claim 13, **characterized** in that the first database (16) comprises information about frequencies measured in an earlier measurement and the interference levels measured in them.

15. An arrangement according to Claim 14, **characterized** in that the information of at least one measured frequency comprise identification information of a base station of the external network detected at the frequency in question.

16. An arrangement according to Claim 14, **characterized** in that the first database (16) also comprises the following earlier measured pieces of information for checking the suitability of the frequency taken into use:

- the signal strength (Rx Level) received when the base station of the internal network transmits a signal on the broadcast control channel (BCCH),

17. An arrangement according to Claim 16, **characterized** in that the data saved earlier also comprise the C/I ratio, which has been calculated by using the samples of the signal strength (Rx Level) received on the broadcast control channel (BCCH) and the interference measurement carried out on other frequencies.

PTO/PCT Rec'd 16 JAN 2002

# Method and arrangement for determining the operating frequencies of base stations of an internal network

The invention relates to redetermining the operating frequencies of base stations of a cellular radio network installed indoors, when the operating conditions of the internal network have changed from the previous situation.

Here an internal network means a cellular radio network or a part of a cellular radio network implemented indoors or in an otherwise restricted area. Here an external network means another cellular radio network or a part of a cellular radio network detected in the area of the internal network.

A problem with the known solutions is the fact that measurements have to be carried out again when changes have taken place in the operating frequencies of the base stations in the environment. This change causes a change of the spurious frequencies in the internal network, which may cause a deterioration in the quality of the connections of the internal network.

In addition, the need for a measuring device with sufficiently high capacity for performing a quick and accurate frequency scanning, due to the width of the frequency band to be measured, is a problem with the prior art solutions.

It is an objective of the invention to present a new, more advantageous solution for determining the operating frequencies of the base stations of the internal network and a method, which enables redetermination of the frequencies of the internal network without a new measurement of the interference level.

The invention relates to a method for redetermining the operating frequencies of the base stations of an internal network, when the operating conditions of the internal network have changed. According to the invention, the redetermination of the operating frequencies is performed on the basis of a frequency measurement performed for earlier determination on a certain measurement route and the information of the external network.

Here a change in the operating conditions of the internal network means at least an increase or decrease of base stations of the external network, changing of the operating frequencies and/or transmission powers and a change in the propagation of radiowaves caused by external conditions.

The invention also relates to an arrangement for redetermining the operating frequencies of the base stations of an internal network, which have earlier been determined by frequency measurement, when the operating conditions of the internal network have changed. According to the invention, it includes data processing means for redetermining the operating frequencies on the basis of a frequency measurement performed on a certain measurement route for earlier determination and the information of the external network.

A special device for measuring interfering frequencies in order to find suitable frequencies inside a building according to a secret patent application FI 981491 (Configuration method for a base station) of the same applicant is preferably used in the frequency measurement. The device is used to measure the intensity of the interference level at the frequencies used by the cellular network. The device is moved in the building in the desired area of the internal network for finding free frequencies. On the basis of the measurement, operating frequencies with a lower interference level than the required field strength are charted for the base stations.

The spurious frequency spectrum is measured once in the area of the internal network, e.g. inside a building, plant area etc. for finding the frequency restrictions caused by the radio transmission of the external network to the internal network. The measurement data are transferred from the measuring device preferably by a data call to the Network Management System (NMS). The measuring device is then preferably a special mobile station adapted for use in measurements. At first, the frequencies of the base stations of the internal network are selected on the basis of the measurement. The external network may later start interfering with the internal network strongly, if a frequency already being used in the internal network is taken into use in a base station of the external network near the internal network. According to the invention, the original measurement and the frequency plans of the external network are used in the new planning of the frequencies of the internal network. Thus the area of the internal network need not be visited again for a new measurement.

The method functions especially well if it has been possible to measure and save during the measurement the cell information of radio transmissions of external cells that can be heard in the area of the internal network. If one of the frequencies being used in the internal network is given to a cell of the external network detected in the measurement, it is known for certain that the frequency of the base station of the internal network must be changed.

In addition, the frequencies selected for the use of the internal network can be checked after the selection by the measurement of the reception level and the Carrier/Interference ratio. This is preferably performed by a measuring device according to the invention.

Preferred embodiments of the invention are set forth in the dependent claims.

In the following, the invention will be described in greater detail with reference to the accompanying drawing, in which

Figure 1 is a flow chart of a method according to a preferred embodiment of the invention for selecting the operating frequencies of the internal network,

Figure 2 is a block diagram of an arrangement according to a preferred embodiment of the invention,

Figure 3 shows an example of a measurement route for measuring the interfering frequencies,

Figure 4 shows a saving form of the measurement results according to a preferred embodiment of the invention, and

Figure 5 is a flow chart of a method according to a preferred embodiment of the invention for finding the most suitable operating frequencies of the internal network.

Figures 1A and 1B show a divided flow chart of a method according to the invention for changing earlier determined operating frequencies of the internal network on the basis of the operating frequencies of the base stations of the external network and earlier measurement information.

Figure 1A illustrates the following. In the network control system, the results of the earlier measurement of the interfering frequency spectrum are preferably saved as grouped according to the base stations of the internal network 1.

It is examined with the network control system if there are changes in the external network 2, which have not been handled with regard to the internal network. If there are changes that have not been handled, it is examined if the frequency used in the internal network has been taken into use in the external network 3. If the frequency taken into use in the base station of the external network is not in use in the internal network, the process returns to step 2 to examine if there are still changes of the

external network, which have not yet been handled. Correspondingly, if it is found out in step 3 that the frequency taken into use in a base station of the external network is in use in the internal network, the process moves to examine if the base station being changed is the new base station installed now 4, which did not exist earlier in the surrounding cellular radio network. If the base station is new and possibly at an interfering distance, which can be discovered when the radio network is being planned, as a precaution the base station of the internal network, the frequency of which is used by the new base station of the external network, is changed to an interference-free frequency on the basis of an earlier measurement and changes of the external network 6. If the base station of the external network is not new and interferes with the internal network on the basis of an earlier measurement 5, the base station of the internal network, the frequency of which is used by a base station of the external network, is changed to an interference-free frequency on the basis of an earlier measurement and changes of the external network 6. If the base station of the external network is not new and has not been interfering before, the process returns to step 2 to examine if there are still changes of the external network left, which have not been handled yet. If there are no unhandled changes of the external network left 2, the process is stopped. It is clear to a person skilled in the art that in steps 3 to 5 of the method described above it is generally examined if a frequency used in a base station of the internal network has been taken into use in the external network, as a result of which an interference-free frequency is changed to the base station of the internal network on the basis of the earlier measurement and the frequencies of the external network, when required.

From Fig. 1B it is seen how an interference-free frequency or a frequency which was originally interference-free and which has not been abandoned in the internal network because of frequency changes of the external network is selected on the basis of an earlier measurement and changes of the external network. In the first step, a first frequency is selected from the frequency range reserved for the internal network 7, which first frequency is not being used by such a base station of the internal network, which could cause interference to the base station for which a new interference-free frequency is being selected. In the next step it is examined if the frequency was interference-free on the basis of an earlier measurement 2. If the frequency is interference-free on the basis of the measurement, it is examined if the frequency has remained interference-free from the changes of the external network 9, and if it has, the selected frequency is taken into use 10. If the frequency was not interference-free in the measurement, it can be examined if the frequency has become interference-free from the changes of the external network 11 and it can be

# PATENT COOPERATION TREATY

SKU/PKK

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

Berggren Oy Ab
18 -07- 2001

# PCT

## WRITTEN OPINION

(PCT Rule 66)

fr. 16/9-01 pw/plw

| | |
|---|---|
| Date of mailing *(day/month/year)* | 16.07.2001 |
| Applicant's or agent's file reference: BP100021 | **REPLY DUE** **within 2 month(s)** from the above date of mailing |

| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
|---|---|---|
| PCT/FI00/00657 | 21/07/2000 | 23/07/1999 |

International Patent Classification (IPC) or both national classification and IPC
H04Q7/36

Applicant
NOKIA NETWORKS OY et al.

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

| | | |
|---|---|---|
| I | ☒ | Basis of the opinion |
| II | ☐ | Priority |
| III | ☐ | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| IV | ☐ | Lack of unity of invention |
| V | ☒ | Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| VI | ☒ | Certain document cited |
| VII | ☒ | Certain defects in the international application |
| VIII | ☒ | Certain observations on the international application |

3. The applicant is hereby **invited to reply** to this opinion.

**When?** See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

**How?** By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

**Also:** For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis.
For an informal communication with the examiner, see Rule 66.6.

**If no reply is filed**, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 23/11/2001.


Name and mailing address of the international preliminary examining authority:
European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer / Examiner
Oteo Mayayo, C

Formalities officer (incl. extension of time limits)
Finnie, A
Telephone No. +49 89 2399 8251

## I. Basis of the opinion

1. With regard to the **elements** of the international application (Replacement *sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*):

**Description, pages:**

1-9 as originally filed

**Claims, No.:**

1-17 as originally filed

**Drawings, sheets:**

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

| | | |
|---|---|---|
| Novelty (N) | Claims | |
| Inventive step (IS) | Claims | 1-17 |
| Industrial applicability (IA) | Claims | |

2. Citations and explanations
**see separate sheet**

**VI. Certain documents cited**

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
**see separate sheet**

## 1. Concerning Item I

**Basis of the opinion**

Reference is made to the following documents:

D1: EP-A2-0716555
D2: US-A-5475869

## 2. Concerning Item V

**Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

2.1 The document D1 is regarded as being the closest prior art to the subject-matter of **claim 1**, and insofar as this claim can be understood (see Section VIII), this document shows the following features thereof (the references in parentheses applying to this document):

(i) A method for redetermining the operating frequencies (see D1, abstract: "... a base station repeats measuring ... and selects, based on such stored levels, an allocated channel for communication with a mobile station in the cell ...") of base stations of an internal network (see D1, abstract: "...This invention is applicable to channel reuse in a microcellular mobile communication system...") when the operating conditions of the internal network have changed (see D1, column 1, lines 31-38: "In compliance with the dynamic channel allocation the radio channels are not assigned to individual cells. Instead, the base station measures... and selects as the allocated channel one of the radio channels..."), characterised in that

(ii) the redetermination of the operating frequencies is performed on the basis of a frequency measurement performed for an earlier determination (see D1, column 6, lines 15-19: "the control means selecting the allocated channel based on the stored level which includes the stored in response to the measured level

measured additionally by the additional measuring means")

The subject-matter of claim 1 differs from D1 only in that in D1 there is no explicit reference to "the redetermination of the operating frequencies is performed on the basis of the information of the external network" but it is only said that "regular measuring means for measuring an interference signal level of each radio channel" (D1, column 6, lines 1-3) are used, but those radio channels could belong as well to some of the base stations of the so-called internal network.

It is however generally known to the person skilled in the art, as well as disclosed in document D2 (which discloses a radio base station capable of distinguishing between interference due to collisions of outgoing call signals and an external interference noise, see D2, column 1, lines 45-49: "It is an object of this invention to provide a radio base station capable of distinguishing between interference due to collisions of outgoing call signals and an external interference noise"), that the feature of "being capable of distinguishing an external interference noise" is an equivalent to the feature "on the basis of the information of the external network" of document D1 and can be interchanged with that feature where circumstances make it desirable.

Thus, the subject-matter of **claim 1** lacks an inventive step and does not meet the requirements of Article 33(3) PCT.

2.2 Independent **claim 12** contains in terms of apparatus features all the features of claim 1.

The only additional feature included in claim 12 are the data processing means for the redetermination of the operating frequencies. However, this feature is already disclosed in document D1, column 7, lines 2-7: "control means for calculating, in connection with each microcell base station, a channel count of free channels..."

Therefore, the subject-matter of **claim 12** does not involve an inventive step in the sense of Article 33(3) PCT (see point above).

2.3 **Dependent claims 2 to 11 and 13 to 17** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step in the sense of Article 33(3) PCT.

## 3. Concerning Item VI

**Certain documents cited**

Certain published documents (Rule 70.10)

| Application No Patent No | Publication date *(day/month/year)* | Filing date *(day/month/year)* | Priority date *(valid claim)* *(day/month/year)* |
|---|---|---|---|
| WO 00/01177 | 06.01.2000 | 29.06.1999 | 29.06.1998 |

## 4. Concerning Item VII

**Certain defects in the international application**

If the applicant wishes to proceed with the application the following matters should also receive attention:

The opening part of the description should be brought into conformity with the wording of the claim of broadest scope as finally amended.

In the description it seems that in page 4, line 32 what is meant is "...on the basis of an earlier measurement 8" instead of "...on the basis of an earlier measurement 2", as it is referring to step 8 in Figure 1B.

In order to facilitate the examination of the conformity of the amended application with the requirements of Article 19(2), 34(2) PCT, the applicant is requested to clearly identify the amendments carried out, irrespective of whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based.

The attention of the applicant is finally drawn to the fact that the application should, for

reasons of conciseness, include only the minimum necessary number of independent claims comprising all the essential technical features of the invention (Rule 6.4(a)-(c) PCT) and may not be amended in such a way that it contains subject-matter beyond the content of the application as originally filed (Articles 19(2) and 34(2) (b) PCT).

## 5. Concerning Item VIII

**Certain observations on the international application**

5.1 The application does not meet the requirements of Article 6 PCT, because **independent claims 1 and 12** as well as **dependent claims 2 to 7, 11, 13 and 14 to 15** are not clear for the following reason:

It is not clear what is meant by the terms "internal network" and "external network". Those terms do not have any generic or standard significance.

As in the description is disclosed the meaning of those terms (page 1, lines 7-10: "Here an internal network means a cellular radio network or a part of a cellular radio network implemented indoors or in an otherwise restricted area. Here an external network means another cellular radio network or a part of a cellular radio network detected in the area of the internal network".), then those meanings should be included in the claims mentioned before in order to make the claims self-contained, and not referring implicitly to the description, as they are now.

5.2 Furthermore, independent **claims 1 and 12** are also unclear because the claims are referring to the result to be achieved ("the redetermination ... is performed on the basis of a frequency measurement ... and the information of the external network"), but it is not disclosed how to arrive at that result and, therefore, the skilled person would not know how to choose the appropriate way of implementing said method in the case of claim 1 or said apparatus in the case of claim 12.

# PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BERGGREN OY AB
P.O. Box 16
FIN-00101 Helsinki
FINLANDE

SLO/PKL

Berggren Oy Ab
23 -10- 2001

# PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

| | |
|---|---|
| Date of mailing *(day/month/year)* | 25.10.2001 |
| Applicant's or agent's file reference<br>BP100021 | **IMPORTANT NOTIFICATION** |

| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
|---|---|---|
| PCT/FI00/00657 | 21/07/2000 | 23/07/1999 |

Applicant
NOKIA NETWORKS OY et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

| Name and mailing address of the IPEA/ | Authorized officer |
|---|---|
| European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Finnie, A<br><br>Tel.+49 89 2399-8251 |

Form PCT/IPEA/416 (July 1992)

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| Applicant's or agent's file reference | FOR FURTHER ACTION | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| BP100021 | | |
| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
| PCT/FI00/00657 | 21/07/2000 | 23/07/1999 |
| International Patent Classification (IPC) or national classification and IPC<br>H04Q7/36 | | |
| Applicant<br>NOKIA NETWORKS OY et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☒ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 20/02/2001 | 25.10.2001 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized officer<br>Oteo Mayayo, C<br>Telephone No. +49 89 2399 7563 |

Form PCT/IPEA/409 (cover sheet) (January 1994)

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/FI00/00657

## I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
**Description, pages:**

| | | |
|---|---|---|
| 5-9 | as originally filed | |
| 1-4,4a | with telefax of | 17/09/2001 |

**Claims, No.:**

| | | |
|---|---|---|
| 1-17 | with telefax of | 17/09/2001 |

**Drawings, sheets:**

| | |
|---|---|
| 1/4-4/4 | as originally filed |

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 1-17 |
| | No: | Claims | |
| Inventive step (IS) | Yes: | Claims | 1-11 |
| | No: | Claims | 12-17 |
| Industrial applicability (IA) | Yes: | Claims | 1-17 |
| | No: | Claims | |

2. Citations and explanations
   **see separate sheet**

**VI. Certain documents cited**

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

   **see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
**see separate sheet**

## 1. Concerning Item I

**Basis of the opinion**

Reference is made to the following documents:

D1: EP-A2-0716555
D2: US-A-5475869

## 2. Concerning Item V

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

The present invention relates to a **method** for redetermining the operating frequencies of base stations of a first cellular radio network (internal network) implemented indoors (i.e. when the operating conditions of a first cellular radio network have changed) and to a corresponding **arrangement** for that redetermination of frequencies, according to independent **claims 1 and 12**.

2.1 In the method disclosed in the document cited in the International Search Report and considered as the closest prior art (D1: **EP 0716555, 12.06.1996**), the feature of "the redetermination of the operating frequencies being performed on the basis of information about a frequency plan of an external network, which is a second cellular radio network or part of a second cellular radio network detected in the area of the internal network, by examining if a frequency, which interferes with the base station of the internal network, has been taken into use in the external network" is not disclosed.

The problem solved by the present invention is regarded as how to use information about a frequency plan of an external network, for redetermining the operational frequencies of base stations of an internal network. The solution to said problem is that information about a frequency plan of an external network is used by examining if a frequency, which interferes with the base station of the internal network, has been taken into use in the external network .

The method according to claim 1 differs from that of D1 in that in D1 it is disclosed the use of frequency measurement performed for an earlier determination as well as storage of that measurement, but not the use of information about a frequency plan of an external network by examination of a frequency, which interferes with the base station of the internal network, to decide if it has been taken into use in the external network.

Therefore, the skilled person would not be prompted to derive a method according to independent **claim 1** from D1. Thus, claim 1 is considered to be **new** and to **involve an inventive step**, Articles 33 (2) and (3) PCT.

2.2 **Claims 2 to 11** are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

2.3 The document D1 is regarded as being the closest prior art to the subject-matter of **claim 12**, and insofar as this claim can be understood (see Section VIII), this document shows the following features thereof (the references in parentheses applying to this document):

(i) An arrangement for redetermining the operating frequencies (see D1, abstract: "... a base station repeats measuring ... and selects, based on such stored levels, an allocated channel for communication with a mobile station in the cell ...") of base stations of an internal network, which is a first cellular network or a part of a first cellular network implemented indoors or in an otherwise restricted area (see D1, abstract: "...This invention is applicable to channel reuse in a microcellular mobile communication system...") when the operating frequencies have been earlier determined by frequency measurement but the operating conditions of the internal network have changed (see D1, column 1, lines 31-38: "In compliance with the dynamic channel allocation the radio channels are not assigned to individual cells. Instead, the base station measures... and selects as the allocated channel one of the radio channels..."), characterised in that

(ii) it includes data processing means for the redetermination of the operating frequencies (see document D1, column 7, lines 2-7: "control means for calculating, in connection with each microcell base station, a channel count of free

channels...")

(iii) on the basis of a frequency measurement performed for an earlier determination (see D1, column 6, lines 15-19: "the control means selecting the allocated channel based on the stored level which includes the stored in response to the measured level measured additionally by the additional measuring means")

(iv) said data processing means including a database for saving the operating frequencies in use at the base stations of the external network (see document D1, column 6, lines 4-5: "storing means for storing the measured level as a stored level";).

The subject-matter of claim 12 differs from D1 only in that in D1 there is no explicit reference to "the redetermination of the operating frequencies is performed on the basis of the information of the external network" but it is only said that "regular measuring means for measuring an interference signal level of each radio channel" (D1, column 6, lines 1-3) are used, but those radio channels could belong as well to some of the base stations of the so-called internal network.

It is however generally known to the person skilled in the art, as well as disclosed in document D2 (which discloses a radio base station capable of distinguishing between interference due to collisions of outgoing call signals and an external interference noise, see D2, column 1, lines 45-49: "It is an object of this invention to provide a radio base station capable of distinguishing between interference due to collisions of outgoing call signals and an external interference noise"), that the feature of "being capable of distinguishing an external interference noise" is an equivalent to the feature "on the basis of the information of the external network" of document D1 and can be interchanged with that feature where circumstances make it desirable.

Thus, the subject-matter of **claim 12** lacks an inventive step and does not meet the requirements of Article 33(3) PCT.

2.4 **Dependent claims 13 to 17** do not contain any features which, in combination with the features of claim 12 to which they refer, meet the requirements of the

PCT in respect of inventive step in the sense of Article 33(3) PCT.

2.5 The present invention is **susceptible of industrial application**, Article 33 (4) PCT.

## 3. Concerning Item VI
**Certain documents cited**

Certain published documents (Rule 70.10)

| Application No Patent No | Publication date *(day/month/year)* | Filing date *(day/month/year)* | Priority date *(valid claim)* *(day/month/year)* |
|---|---|---|---|
| WO 00/01177 | 06.01.2000 | 29.06.1999 | 29.06.1998 |

Although this document (WO 00/01177) is not prior art according to Rule 64.1(a) PCT, it should be noticed that it discloses subject-matter which is considered to be relevant in respect of what is claimed in the present application.

## 4. Concerning Item VIII
**Certain observations on the international application**

The application does not meet the requirements of Article 6 PCT, because **independent claims 1 and 12** are not clear for the following reasons:

4.1 **Independent claims 1 and 12** are not clear since it is unclear what is meant by "implemented indoors or in an otherwise restricted area ...". As all cellular radio networks are implemented in a restricted area (there is no infinite cellular radio network), then these terms are vague and too broad and leave the reader in doubt regarding the definition of "internal network".

4.2 Furthermore, independent **claim 12** is also unclear because the claim is referring to the result to be achieved ("the redetermination ... is performed on the basis of a frequency measurement ... and the information of the external

network"), but it is not disclosed how to arrive at that result and, therefore, the skilled person would not know how to choose the appropriate way of implementing said arrangement in claim 12.

# Method and arrangement for determining the operating frequencies of base stations of an internal network

The invention relates to redetermining the operating frequencies of base stations of a cellular radio network installed indoors, when the operating conditions of the internal network have changed from the previous situation.

Here an internal network means a cellular radio network or a part of a cellular radio network implemented indoors or in an otherwise restricted area. Here an external network means another cellular radio network or a part of a cellular radio network detected in the area of the internal network.

A problem with the known solutions is the fact that measurements have to be carried out again when changes have taken place in the operating frequencies of the base stations in the environment. This change causes a change of the spurious frequencies in the internal network, which may cause a deterioration in the quality of the connections of the internal network.

In addition, the need for a measuring device with sufficiently high capacity for performing a quick and accurate frequency scanning, due to the width of the frequency band to be measured, is a problem with the prior art solutions.

A known prior art publication number EP 0 716 555 A2 exists in which each base station of a cellular radio system performs repeated measurements on interference levels and selects into use such channels where the level of measured interference is low. Another known prior art publication number US 5,475,869 introduces an arrangement where also measurements describing interference from external networks are taken into account during channel allocation.

It is an objective of the invention to present a new, more advantageous solution for determining the operating frequencies of the base stations of the internal network and a method, which enables redetermination of the frequencies of the internal network without a new measurement of the interference level.

The invention relates to a method for redetermining the operating frequencies of the base stations of an internal network, when the operating conditions of the internal network have changed. The characteristic features of the method according to the

invention are recited in the characterising portion of the independent claim directed to a method.

Here a change in the operating conditions of the internal network means at least an increase or decrease of base stations of the external network, changing of the operating frequencies and/or transmission powers and a change in the propagation of radiowaves caused by external conditions.

The invention also relates to an arrangement for redetermining the operating frequencies of the base stations of an internal network, which have earlier been determined by frequency measurement, when the operating conditions of the internal network have changed. The characteristic features of the arrangement according to the invention are recited in the characterising portion of the independent claim directed to an arrangement.

A special device for measuring interfering frequencies in order to find suitable frequencies inside a building according to a secret patent application FI 981491 (Configuration method for a base station) of the same applicant is preferably used in the frequency measurement. The device is used to measure the intensity of the interference level at the frequencies used by the cellular network. The device is moved in the building in the desired area of the internal network for finding free frequencies. On the basis of the measurement, operating frequencies with a lower interference level than the required field strength are charted for the base stations.

The spurious frequency spectrum is measured once in the area of the internal network, e.g. inside a building, plant area etc. for finding the frequency restrictions caused by the radio transmission of the external network to the internal network. The measurement data are transferred from the measuring device preferably by a data call to the Network Management System (NMS). The measuring device is then preferably a special mobile station adapted for use in measurements. At first, the frequencies of the base stations of the internal network are selected on the basis of the measurement. The external network may later start interfering with the internal network strongly, if a frequency already being used in the internal network is taken into use in a base station of the external network near the internal network. According to the invention, the original measurement and the frequency plans of the external network are used in the new planning of the frequencies of the internal network. Thus the area of the internal network need not be visited again for a new measurement.

The method functions especially well if it has been possible to measure and save during the measurement the cell information of radio transmissions of external cells that can be heard in the area of the internal network. If one of the frequencies being used in the internal network is given to a cell of the external network detected in the measurement, it is known for certain that the frequency of the base station of the internal network must be changed.

In addition, the frequencies selected for the use of the internal network can be checked after the selection by the measurement of the reception level and the Carrier/Interference ratio. This is preferably performed by a measuring device according to the invention.

Preferred embodiments of the invention are set forth in the dependent claims.

In the following, the invention will be described in greater detail with reference to the accompanying drawing, in which

Figure 1 is a flow chart of a method according to a preferred embodiment of the invention for selecting the operating frequencies of the internal network,

Figure 2 is a block diagram of an arrangement according to a preferred embodiment of the invention,

Figure 3 shows an example of a measurement route for measuring the interfering frequencies,

Figure 4 shows a saving form of the measurement results according to a preferred embodiment of the invention, and

Figure 5 is a flow chart of a method according to a preferred embodiment of the invention for finding the most suitable operating frequencies of the internal network.

Figures 1A and 1B show a divided flow chart of a method according to the invention for changing earlier determined operating frequencies of the internal network on the basis of the operating frequencies of the base stations of the external network and earlier measurement information.

Figure 1A illustrates the following. In the network control system, the results of the earlier measurement of the interfering frequency spectrum are preferably saved as grouped according to the base stations of the internal network 1.

It is examined with the network control system if there are changes in the external network 2, which have not been handled with regard to the internal network. If there are changes that have not been handled, it is examined if the frequency used in the internal network has been taken into use in the external network 3. If the frequency taken into use in the base station of the external network is not in use in the internal network, the process returns to step 2 to examine if there are still changes of the external network, which have not yet been handled. Correspondingly, if it is found out in step 3 that the frequency taken into use in a base station of the external network is in use in the internal network, the process moves to examine if the base station being changed is the new base station installed now 4, which did not exist earlier in the surrounding cellular radio network. If the base station is new and possibly at an interfering distance, which can be discovered when the radio network is being planned, as a precaution the base station of the internal network, the frequency of which is used by the new base station of the external network, is changed to an interference-free frequency on the basis of an earlier measurement and changes of the external network 6. If the base station of the external network is not new and interferes with the internal network on the basis of an earlier measurement 5, the base station of the internal network, the frequency of which is used by a base station of the external network, is changed to an interference-free frequency on the basis of an earlier measurement and changes of the external network 6. If the base station of the external network is not new and has not been interfering before, the process returns to step 2 to examine if there are still changes of the external network left, which have not been handled yet. If there are no unhandled changes of the external network left 2, the process is stopped. It is clear to a person skilled in the art that in steps 3 to 5 of the method described above it is generally examined if a frequency used in a base station of the internal network has been taken into use in the external network, as a result of which an interference-free frequency is changed to the base station of the internal network on the basis of the earlier measurement and the frequencies of the external network, when required.

From Fig. 1B it is seen how an interference-free frequency or a frequency which was originally interference-free and which has not been abandoned in the internal network because of frequency changes of the external network is selected on the basis of an earlier measurement and changes of the external network. In the first step, a first frequency is selected from the frequency range reserved for the internal network 7, which first frequency is not being used by such a base station of the internal network, which could cause interference to the base station for which a new interference-free frequency is being selected. In the next step it is examined if the

frequency was interference-free on the basis of an earlier measurement 8. If the frequency is interference-free on the basis of the measurement, it is examined if the frequency has remained interference-free from the changes of the external network 9, and if it has, the selected frequency is taken into use 10. If the frequency was not interference-free in the measurement, it can be examined if the frequency has become interference-free from the changes of the external network 11 and it can be

**Claims**

1. A method for redetermining the operating frequencies of base stations of an internal network, which is a first cellular radio network or a part of a first cellular radio network implemented indoors or in an otherwise restricted area, when the operating conditions of the internal network have changed, **characterized** in that the redetermination of the operating frequencies is performed on the basis of a frequency measurement performed for an earlier determination and information about a frequency plan of an external network, which is a second cellular radio network or a part of a second cellular radio network detected in the area of the internal network, by examining (3-5) if a frequency, which interferes with the base station of the internal network, has been taken into use in the external network.

2. A method according to Claim 1, **characterized** in that it includes the following steps:

- saving (1) the results of an earlier measurement, and

- if an interfering frequency is detected (3-5), changing (6) an interference-free frequency to the base station of the internal network on the basis of an earlier measurement and the information about the frequency plan of the external network.

3. A method according to Claim 1, **characterized** in that of the results of the earlier measurement, at least the frequency and the interference level and the identification information of that base station of the external network, which produces the interfering transmission, are saved (1) for the base stations of the internal network.

4. A method according to Claim 1, **characterized** in that when it is noticed that a base station recognized on the basis of an earlier measurement receives (9) in the new frequency plan a frequency already being used in a base station of the internal network, the frequency of the internal network is changed (6) to an interference-free frequency.

5. A method according to Claim 1, **characterized** in that when it is noticed that a base station recognized on the basis of an earlier measurement receives (9) in the new frequency plan a frequency which interferes with a frequency already being used in a base station of the internal network, the frequency of the base station of the internal network is changed (6) to an interference-free frequency.

6. A method according to Claim 1, **characterized** in that when it is detected (11) from the frequency plan that a frequency that was used by the external network and found to be affected by interference in an earlier measurement has become interference-free because it is not used any more, this frequency is taken into use by the internal network.

7. A method according to Claim 1, **characterized** in that it also includes the following steps for checking the suitability of the frequency to be taken into use:

- measuring (22) the signal strength (Rx Level) received in the area of the internal network in the measurement route when the base station of the internal network transmits a signal on the broadcast control channel (BCCH),

- examining (23) if a certain predetermined proportion of the measurement samples of the signal strength is higher than a minimum value set in advance.

8. A method according to Claim 7, **characterized** in that the C/I ratio is calculated (25) by using the measured samples of the signal strength (Rx Level) of the broadcast control channel (BCCH) and the interference measurement performed on the frequencies to be compared.

9. A method according to Claim 8, **characterized** in that

- it is examined (26) if the C/I ratio is better than a certain predetermined minimum value in all the samples, and

- the frequency is accepted (30) if the signal strength is sufficient and the C/I ratio is better than a certain limit.

10. A method according to Claim 7, **characterized** in that in addition, to prevent the crosstalk of an adjacent channel, a measurement and examination (28) for accepting (30) the frequency is performed.

11. A method according to Claim 10, **characterized** in that the strength of both adjacent channels is at the most by a certain predetermined maximum value higher than the signal strength of the channel being considered.

12. An arrangement for redetermining the operating frequencies of base stations of an internal network, which is a first cellular radio network or a part of a first cellular radio network implemented indoors or in an otherwise restricted area, when the operating frequencies have been earlier determined by frequency measurement but

the operating conditions of the internal network have changed, **characterized** in that it includes data processing means (13, 14, 15, 16, 17) for the redetermination of the operating frequencies on the basis of a frequency measurement performed for an earlier determination and information of an external network, which is a second cellular radio network or a part of a second cellular radio network detected in the area of the internal network, said data processing means including a database (17) for saving the operating frequencies in use at base stations of the external network.

13. An arrangement according to Claim 12, **characterized** in that it includes

- a first database (16) for saving the information of a measurement performed earlier,

- a second database (17) for saving the operating frequencies of base stations of the external network, and

- a processor (13) for the redetermination of the operating frequencies of base stations of the internal network carried out on the basis of the information of the first database and the second database.

14. An arrangement according to Claim 13, **characterized** in that the first database (16) comprises information about frequencies measured in an earlier measurement and the interference levels measured in them.

15. An arrangement according to Claim 14, **characterized** in that the information of at least one measured frequency comprise identification information of a base station of the external network detected at the frequency in question.

16. An arrangement according to Claim 14, **characterized** in that the first database (16) also comprises the following earlier measured pieces of information for checking the suitability of the frequency taken into use:

- the signal strength (Rx Level) received when the base station of the internal network transmits a signal on the broadcast control channel (BCCH),

17. An arrangement according to Claim 16, **characterized** in that the data saved earlier also comprise the C/I ratio, which has been calculated by using the samples of the signal strength (Rx Level) received on the broadcast control channel (BCCH) and the interference measurement carried out on other frequencies.

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

| Applicant's or agent's file reference BP100021 | FOR FURTHER ACTION | see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. |
|---|---|---|
| International application No. PCT/FI 00/00657 | International filing date *(day/month/year)* 21 July 2000 | (Earliest) Priority Date *(day/month/year)* 23 July 1999 |
| Applicant Nokia Networks OY et al | | |

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readable form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (See Box II).

4. With regard to the **title**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1A

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00657

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/36, H04Q 7/30, H04B 7/26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | EP 0716555 A2 (NEC CORPORATION), 12 June 1996 (12.06.96), column 4, line 16 - column 7, line 48; column 16, line 48 - column 20, line 45, figures 1, 8,9,10, claims 1-19, abstract<br>-- | 1-6,12-15 |
| Y | US 5475869 A (MASATOSHI GOMI ET AL), 12 December 1995 (12.12.95), column 1, line 46 - column 3, line 3; column 3, line 62 - column 4, line 26; column 4, line 54 - column 7, line 1, figures 3,5, claims 1-7, abstract | 1-6,12-15 |
| A | -- | 7-11,16,17 |

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 22 December 2000 | 22 -12- 2000 |
| Name and mailing address of the ISA/<br>Swedish Patent Office<br>Box 5055, S-102 42 STOCKHOLM<br>Facsimile No. +46 8 666 02 86 | Authorized officer<br>Klas Arvidsson/mj<br>Telephone No. +46 8 782 25 00 |

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00657

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| P,X | WO 0001177 A1 (NOKIA NETWORKS OY), 6 January 2000 (06.01.00), page 2, line 1 - page 3, line 8; page 3, line 19 - page 8, line 34, figures 1-4, claims 1-9, abstract<br>-- | 1-17 |
| A | US 5846209 A (YASUHARU IWATA), 1 December 1998 (01.12.98), column 2, line 1 - line 25, figure 1, claims 1-8, abstract<br>-- | 1-17 |
| A | GB 2325818 A (RADIO FREQUENCY SYSTEMS INC.), 2 December 1998 (02.12.98), page 2, line 16 - page 6, line 14, figure 1, claims 1-18, abstract<br>-- | 1-17 |

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

04/12/00

International application No.
PCT/FI 00/00657

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 0716555 A2 | 12/06/96 | JP 2586840 B | 05/03/97 |
| | | JP 8163630 A | 21/06/96 |
| | | US 5752192 A | 12/05/98 |
| US 5475869 A | 12/12/95 | GB 2282736 A,B | 12/04/95 |
| | | GB 9410720 D | 00/00/00 |
| | | JP 7099471 A | 11/04/95 |
| WO 0001177 A1 | 06/01/00 | AU 4912699 A | 17/01/00 |
| | | FI 981491 A | 30/12/99 |
| US 5846209 A | 01/12/98 | AU 2889095 A | 09/02/96 |
| | | EP 0767831 A | 16/04/97 |
| | | FI 1592 U | 26/10/94 |
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| GB 2325818 A | 02/12/98 | CA 2217812 A | 30/09/98 |
| | | GB 9806946 D | 00/00/00 |
| | | JP 10285646 A | 23/10/98 |
| | | SE 9801028 A | 01/10/98 |
| | | US 6052605 A | 18/04/00 |

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10/031417
JC13 c'd PCT/PTO 16 JAN 2002

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**REPLY TO WRITTEN OPINION**
**INTERNATIONAL PATENT APPLICATION PCT/FI00/00657**
**APPLICANT: NOKIA NETWORKS OY**
**DUE DATE: 16 SEPTEMBER 2001**

Dear Sirs,

On account of the Written Opinion issued on 16 July 2001 we wish to submit the following in support of the above-referenced patent application:

The applicant admits that the original independent claim indeed raised certain unclarity issues, and was formulated widely enough to run into inventive step considerations in view of documents D1 and D2. The applicant wants to file a set of new claims and replacement pages to the description in order to place the application in condition of patentability over the cited reference documents.

The Examiner has correctly noted that the kind of measurements performed in D2 that describe "external interference noise" indeed produce information about the external cellular system, although only measuring detectable interference leaves the information on a level of relatively high indefiniteness. When the applicant claimed using "information of the external network", he actually meant something much more definite: explicit information that has been obtained from the external network itself rather than just measurement results that describe the effects caused by the external network. The most advantageous way of using such information in the context of the applicant's invention is to check from an explicitly obtained frequency plan, whether a certain interfering frequency has been taken in use in the external network.

In the amended independent claims the definitions of the internal and external networks have been added. They appear in the claims in the same form that is used on page 1, lines 7-10 of the original description, so they are in perfect accordance with Art. 19(2) and 34(2) PCT.

In the independent method claim the phrase "the information of the external network", where the definite article for "information" was a potential source

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of unclarity, has been changed to "information about a frequency plan of an external network". The term "frequency plan" has been extensively used in the application as filed (e.g. claims 4-6), so it does not introduce any added subject matter in this new use in claim 1.

Also in the independent method claim the explanation "by examining (3-5) if a frequency, which interferes with the base station of the internal network, has been taken into use in the external network" is now introduced to clarify the frequency redetermination process. This phrase comes directly from original claim 2, and is therefore in accordance with Art. 19(2) and 34(2) PCT.

Adding said phrase from claim 2 into claim 1 has caused a corresponding deletion in claim 2.

In the independent arrangement claim (claim 12) the functional feature of examining whether a certain frequency has been taken into use would be improper. The applicant has chosen to introduce into the independent arrangement claim the requirement for the data processing means to include a database for saving the operating frequencies in use at base stations of the external network. Such a database represents the hardware means that are needed to implement the functional feature in the independent method claim, so introducing it into the independent arrangement claim serves to maintain unity of invention simultaneously with drawing a difference between the invention and cited prior art.

In the amended description pages the changes made are the following:
- a short paragraph was added to properly introduce and discuss the relevant disclosure of D1 and D2,
- the paragraphs that refer to the characteristic features of the invention were amended to generally refer to the characteristic portions of the independent claims, and
- the small error in reference numbers pointed at in the Written Opinion was corrected.

We believe that all objections raised in the Written Opinion have been met, and respectfully request positive reconsideration of the merits of the application in its amended form.

**BERGGREN OY AB**

Matti Brax
Patent Attorney

ENCLS Amended pages 1, 2, 3, 4 and 4a of the description
Amended claims (pages 10, 11 and 12)

10/031417
C13 Rec'd PCT/PTO 16 JAN 2002



**Method and arrangement for determining the operating frequencies of base stations of an internal network**

The invention relates to redetermining the operating frequencies of base stations of a cellular radio network installed indoors, when the operating conditions of the internal network have changed from the previous situation.

Here an internal network means a cellular radio network or a part of a cellular radio network implemented indoors or in an otherwise restricted area. Here an external network means another cellular radio network or a part of a cellular radio network detected in the area of the internal network.

A problem with the known solutions is the fact that measurements have to be carried out again when changes have taken place in the operating frequencies of the base stations in the environment. This change causes a change of the spurious frequencies in the internal network, which may cause a deterioration in the quality of the connections of the internal network.

In addition, the need for a measuring device with sufficiently high capacity for performing a quick and accurate frequency scanning, due to the width of the frequency band to be measured, is a problem with the prior art solutions.

A known prior art publication number EP 0 716 555 A2 exists in which each base station of a cellular radio system performs repeated measurements on interference levels and selects into use such channels where the level of measured interference is low. Another known prior art publication number US 5,475,869 introduces an arrangement where also measurements describing interference from external networks are taken into account during channel allocation.

It is an objective of the invention to present a new, more advantageous solution for determining the operating frequencies of the base stations of the internal network and a method, which enables redetermination of the frequencies of the internal network without a new measurement of the interference level.

The invention relates to a method for redetermining the operating frequencies of the base stations of an internal network, when the operating conditions of the internal network have changed. The characteristic features of the method according to the

invention are recited in the characterising portion of the independent claim directed to a method.

Here a change in the operating conditions of the internal network means at least an increase or decrease of base stations of the external network, changing of the operating frequencies and/or transmission powers and a change in the propagation of radiowaves caused by external conditions.

The invention also relates to an arrangement for redetermining the operating frequencies of the base stations of an internal network, which have earlier been determined by frequency measurement, when the operating conditions of the internal network have changed. The characteristic features of the arrangement according to the invention are recited in the characterising portion of the independent claim directed to an arrangement.

A special device for measuring interfering frequencies in order to find suitable frequencies inside a building according to a secret patent application FI 981491 (Configuration method for a base station) of the same applicant is preferably used in the frequency measurement. The device is used to measure the intensity of the interference level at the frequencies used by the cellular network. The device is moved in the building in the desired area of the internal network for finding free frequencies. On the basis of the measurement, operating frequencies with a lower interference level than the required field strength are charted for the base stations.

The spurious frequency spectrum is measured once in the area of the internal network, e.g. inside a building, plant area etc. for finding the frequency restrictions caused by the radio transmission of the external network to the internal network. The measurement data are transferred from the measuring device preferably by a data call to the Network Management System (NMS). The measuring device is then preferably a special mobile station adapted for use in measurements. At first, the frequencies of the base stations of the internal network are selected on the basis of the measurement. The external network may later start interfering with the internal network strongly, if a frequency already being used in the internal network is taken into use in a base station of the external network near the internal network. According to the invention, the original measurement and the frequency plans of the external network are used in the new planning of the frequencies of the internal network. Thus the area of the internal network need not be visited again for a new measurement.

The method functions especially well if it has been possible to measure and save during the measurement the cell information of radio transmissions of external cells that can be heard in the area of the internal network. If one of the frequencies being used in the internal network is given to a cell of the external network detected in the measurement, it is known for certain that the frequency of the base station of the internal network must be changed.

In addition, the frequencies selected for the use of the internal network can be checked after the selection by the measurement of the reception level and the Carrier/Interference ratio. This is preferably performed by a measuring device according to the invention.

Preferred embodiments of the invention are set forth in the dependent claims.

In the following, the invention will be described in greater detail with reference to the accompanying drawing, in which

Figure 1 is a flow chart of a method according to a preferred embodiment of the invention for selecting the operating frequencies of the internal network,

Figure 2 is a block diagram of an arrangement according to a preferred embodiment of the invention,

Figure 3 shows an example of a measurement route for measuring the interfering frequencies,

Figure 4 shows a saving form of the measurement results according to a preferred embodiment of the invention, and

Figure 5 is a flow chart of a method according to a preferred embodiment of the invention for finding the most suitable operating frequencies of the internal network.

Figures 1A and 1B show a divided flow chart of a method according to the invention for changing earlier determined operating frequencies of the internal network on the basis of the operating frequencies of the base stations of the external network and earlier measurement information.

Figure 1A illustrates the following. In the network control system, the results of the earlier measurement of the interfering frequency spectrum are preferably saved as grouped according to the base stations of the internal network 1.

It is examined with the network control system if there are changes in the external network 2, which have not been handled with regard to the internal network. If there are changes that have not been handled, it is examined if the frequency used in the internal network has been taken into use in the external network 3. If the frequency taken into use in the base station of the external network is not in use in the internal network, the process returns to step 2 to examine if there are still changes of the external network, which have not yet been handled. Correspondingly, if it is found out in step 3 that the frequency taken into use in a base station of the external network is in use in the internal network, the process moves to examine if the base station being changed is the new base station installed now 4, which did not exist earlier in the surrounding cellular radio network. If the base station is new and possibly at an interfering distance, which can be discovered when the radio network is being planned, as a precaution the base station of the internal network, the frequency of which is used by the new base station of the external network, is changed to an interference-free frequency on the basis of an earlier measurement and changes of the external network 6. If the base station of the external network is not new and interferes with the internal network on the basis of an earlier measurement 5, the base station of the internal network, the frequency of which is used by a base station of the external network, is changed to an interference-free frequency on the basis of an earlier measurement and changes of the external network 6. If the base station of the external network is not new and has not been interfering before, the process returns to step 2 to examine if there are still changes of the external network left, which have not been handled yet. If there are no unhandled changes of the external network left 2, the process is stopped. It is clear to a person skilled in the art that in steps 3 to 5 of the method described above it is generally examined if a frequency used in a base station of the internal network has been taken into use in the external network, as a result of which an interference-free frequency is changed to the base station of the internal network on the basis of the earlier measurement and the frequencies of the external network, when required.

From Fig. 1B it is seen how an interference-free frequency or a frequency which was originally interference-free and which has not been abandoned in the internal network because of frequency changes of the external network is selected on the basis of an earlier measurement and changes of the external network. In the first step, a first frequency is selected from the frequency range reserved for the internal network 7, which first frequency is not being used by such a base station of the internal network, which could cause interference to the base station for which a new interference-free frequency is being selected. In the next step it is examined if the

frequency was interference-free on the basis of an earlier measurement 8. If the frequency is interference-free on the basis of the measurement, it is examined if the frequency has remained interference-free from the changes of the external network 9, and if it has, the selected frequency is taken into use 10. If the frequency was not interference-free in the measurement, it can be examined if the frequency has become interference-free from the changes of the external network 11 and it can be

**Claims**

1. A method for redetermining the operating frequencies of base stations of an internal network, which is a first cellular radio network or a part of a first cellular radio network implemented indoors or in an otherwise restricted area, when the operating conditions of the internal network have changed, **characterized** in that the redetermination of the operating frequencies is performed on the basis of a frequency measurement performed for an earlier determination and information about a frequency plan of an external network, which is a second cellular radio network or a part of a second cellular radio network detected in the area of the internal network, by examining (3-5) if a frequency, which interferes with the base station of the internal network, has been taken into use in the external network.

2. A method according to Claim 1, **characterized** in that it includes the following steps:

- saving (1) the results of an earlier measurement, and

- if an interfering frequency is detected (3-5), changing (6) an interference-free frequency to the base station of the internal network on the basis of an earlier measurement and the information about the frequency plan of the external network.

3. A method according to Claim 1, **characterized** in that of the results of the earlier measurement, at least the frequency and the interference level and the identification information of that base station of the external network, which produces the interfering transmission, are saved (1) for the base stations of the internal network.

4. A method according to Claim 1, **characterized** in that when it is noticed that a base station recognized on the basis of an earlier measurement receives (9) in the new frequency plan a frequency already being used in a base station of the internal network, the frequency of the internal network is changed (6) to an interference-free frequency.

5. A method according to Claim 1, **characterized** in that when it is noticed that a base station recognized on the basis of an earlier measurement receives (9) in the new frequency plan a frequency which interferes with a frequency already being used in a base station of the internal network, the frequency of the base station of the internal network is changed (6) to an interference-free frequency.

6. A method according to Claim 1, **characterized** in that when it is detected (11) from the frequency plan that a frequency that was used by the external network and found to be affected by interference in an earlier measurement has become interference-free because it is not used any more, this frequency is taken into use by the internal network.

7. A method according to Claim 1, **characterized** in that it also includes the following steps for checking the suitability of the frequency to be taken into use:

- measuring (22) the signal strength (Rx Level) received in the area of the internal network in the measurement route when the base station of the internal network transmits a signal on the broadcast control channel (BCCH),

- examining (23) if a certain predetermined proportion of the measurement samples of the signal strength is higher than a minimum value set in advance.

8. A method according to Claim 7, **characterized** in that the C/I ratio is calculated (25) by using the measured samples of the signal strength (Rx Level) of the broadcast control channel (BCCH) and the interference measurement performed on the frequencies to be compared.

9. A method according to Claim 8, **characterized** in that

- it is examined (26) if the C/I ratio is better than a certain predetermined minimum value in all the samples, and

- the frequency is accepted (30) if the signal strength is sufficient and the C/I ratio is better than a certain limit.

10. A method according to Claim 7, **characterized** in that in addition, to prevent the crosstalk of an adjacent channel, a measurement and examination (28) for accepting (30) the frequency is performed.

11. A method according to Claim 10, **characterized** in that the strength of both adjacent channels is at the most by a certain predetermined maximum value higher than the signal strength of the channel being considered.

12. An arrangement for redetermining the operating frequencies of base stations of an internal network, which is a first cellular radio network or a part of a first cellular radio network implemented indoors or in an otherwise restricted area, when the operating frequencies have been earlier determined by frequency measurement but

the operating conditions of the internal network have changed, **characterized** in that it includes data processing means (13, 14, 15, 16, 17) for the redetermination of the operating frequencies on the basis of a frequency measurement performed for an earlier determination and information of an external network, which is a second cellular radio network or a part of a second cellular radio network detected in the area of the internal network, said data processing means including a database (17) for saving the operating frequencies in use at base stations of the external network.

13. An arrangement according to Claim 12, **characterized** in that it includes

- a first database (16) for saving the information of a measurement performed earlier,

- a second database (17) for saving the operating frequencies of base stations of the external network, and

- a processor (13) for the redetermination of the operating frequencies of base stations of the internal network carried out on the basis of the information of the first database and the second database.

14. An arrangement according to Claim 13, **characterized** in that the first database (16) comprises information about frequencies measured in an earlier measurement and the interference levels measured in them.

15. An arrangement according to Claim 14, **characterized** in that the information of at least one measured frequency comprise identification information of a base station of the external network detected at the frequency in question.

16. An arrangement according to Claim 14, **characterized** in that the first database (16) also comprises the following earlier measured pieces of information for checking the suitability of the frequency taken into use:

- the signal strength (Rx Level) received when the base station of the internal network transmits a signal on the broadcast control channel (BCCH),

17. An arrangement according to Claim 16, **characterized** in that the data saved earlier also comprise the C/I ratio, which has been calculated by using the samples of the signal strength (Rx Level) received on the broadcast control channel (BCCH) and the interference measurement carried out on other frequencies.

Berggren
PATENTTITOIMISTO • PATENT & TRADEMARK ATTORNEYS

10/031417

Rec'd PCT/PTO 16 JAN 2002

EL

9 November 2001

Managing Director:
L. Nordin

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LEGAL MATTERS

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MM

**INTERNATIONAL APPLICATIONS**
**MERGER**

The applicant of the PCT-applications listed below has changed. Nokia has merged its Finnish subsidiaries. As a result, **Nokia Mobile Phones Ltd.** and **Nokia Networks Oy** are now part of **Nokia Corporation**. The previous applicants should thereby be deleted and replaced by the following:

**Nokia Corporation**
**Keilalahdentie 4**
**FIN-02150 Espoo**
**FINLAND**

The applications concerned are:

**Nokia Mobile Phones Ltd.:**

| Application: | Our ref: | Next deadline: |
|---|---|---|
| PCT/FI99/00722 | OP0328 | 1 December 2001 (30 months) |
| PCT/FI00/00519 | 49807 | 10 December 2001 (30 months) |
| PCT/FI00/00529 | 50113 | 14 December 2001 (30 months) |
| PCT/FI00/00538 | 50115 | 16 December 2001 (30 months) |
| PCT/FI00/00620 | 50242 | 9 January 2002 (30 months) |
| PCT/FI00/00591 | 50236 | 19 January 2002 (30 months) |
| PCT/FI00/00652 | BP100052 | 19 January 2002 (30 months) |
| PCT/FI01/00745 | BP102211 | 25 March 2002 (Demand) |
| PCT/FI00/00863 | BP100067 | 8 April 2002 (30 months) |
| PCT/FI00/00917 | BP100182 | 25 April 2002 (30 months) |
| PCT/FI00/00920 | BP100180 | 26 April 2002 (30 months) |
| PCT/FI00/00919 | BP100181 | 26 April 2002 (30 months) |
| PCT/FI00/00955 | BP100396 | 2 May 2002 (30 months) |
| PCT/FI00/01037 | BP100397 | 30 May 2002 (30 months) |
| PCT/FI00/01087 | BP100573 | 15 June 2002 (30 months) |
| PCT/FI00/01088 | BP100572 | 15 June 2002 (30 months) |
| PCT/FI00/01152 | BP100574 | 28 June 2002 (30 months) |
| PCT/FI00/01163 | BP100884 | 30 June 2002 (30 months) |

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| | | |
|---|---|---|
| PCT/FI01/00016 | BP100778 | 10 July 2002 (30 months) |
| PCT/FI01/00023 | BP100715 | 13 July 2002 (30 months) |
| PCT/FI01/00044 | BP100519 | 21 July 2002 (30 months) |
| PCT/FI01/00093 | BP100825 | 1 August 2002 (30 months) |
| PCT/FI01/00152 | BP100546 | 16 August 2002 (30 months) |
| PCT/FI01/00183 | BP100945 | 23 August 2002 (30 months) |
| PCT/FI01/00189 | BP100948 | 24 August 2002 (30 months) |
| PCT/FI01/00190 | BP101049 | 25 August 2002 (30 months) |
| PCT/FI01/00222 | BP101116 | 7 September 2002 (30 months) |
| PCT/FI01/00325 | BP101468 | 4 October 2002 (30 months) |
| PCT/FI01/00353 | BP101149 | 10 October 2002 (30 months) |
| PCT/FI01/00369 | BP101515 | 13 October 2002 (30 months) |
| PCT/FI01/00436 | BP101421 | 8 November 2002 (30 months) |
| PCT/FI01/00438 | BP101639 | 8 November 2002 (30 months) |

**Nokia Networks Oy:**

| Application: | Our ref: | Next deadline: |
|---|---|---|
| PCT/FI00/00555 | 50063 | 21 December 2001 (30 months) |
| PCT/FI00/00561 | 50192 | 24 December 2001 (30 months) |
| PCT/FI00/00615 | 50245 | 5 January 2002 (30 months) |
| PCT/FI00/00621 | 50193 | 9 January 2002 (30 months) |
| PCT/FI00/00622 | 50064 | 9 January 2002 (30 months) |
| PCT/FI00/00647 | 50194 | 14 January 2002 (30 months) |
| PCT/FI00/00654 | 50215 | 19 January 2002 (30 months) |
| PCT/FI00/00657 | BP100021 | 23 January 2002 (30 months) |
| PCT/FI01/00599 | BP101833 | 26 January 2002 (Demand) |
| PCT/FI00/00776 | BP100158 | 16 March 2002 (30 months) |
| PCT/FI00/00786 | BP100427 | 17 March 2002 (30 months) |
| PCT/FI00/00796 | BP100152 | 20 March 2002 (30 months) |
| PCT/FI01/00734 | BP101514 | 22 March 2002 (Demand) |
| PCT/FI01/00776 | BP101753 | 7 April 2002 (Demand) |
| PCT/FI00/00869 | BP100178 | 8 April 2002 (30 months) |
| PCT/FI00/00909 | BP100167 | 20 April 2002 (30 months) |
| PCT/FI00/01021 | BP100719 | 26 May 2002 (30 months) |
| PCT/FI00/01024 | BP100582 | 26 May 2002 (30 months) |
| PCT/FI00/01117 | BP100581 | 20 June 2002 (30 months) |
| PCT/FI01/00014 | BP100868 | 7 July 2002 (30 months) |
| PCT/FI01/00018 | BP100734 | 11 July 2002 (30 months) |
| PCT/FI01/00038 | BP100244 | 17 July 2002 (30 months) |
| PCT/FI01/00120 | BP100777 | 11 August 2002 (30 months) |
| PCT/FI01/00261 | BP100682 | 16 September 2002 (30 months) |
| PCT/FI01/00508 | BP101224 | 29 November 2002 (30 months) |

The change applies to all designated states except the U.S.

Berggren

Nokia Corporation has authorized Berggren Oy Ab, Jaakonkatu 3A, FIN-00100 Helsinki, Finland, to continue to act as their agents in the above applications.

We enclose a copy of a general power of attorney and a copy of the Extract from the Trade Register in Finnish and its translation into English.

We respectfully request that the change of the applicant is recorded as soon as possible.

**BERGGREN OY AB**

Encl. Copy of general power of attorney
Copy of Extract from the Trade Register in Finnish
Copy of Extract from the Trade Register, English translation

*The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:*

IPEA/ EP

# PCT

## DEMAND

PCT Chapter II
MU DG 2

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

| Identification of IPEA | Date of receipt of DEMAND |
|---|---|
| | |

**Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION**

Applicant's or agent's file reference: BP100021/SKU/PKK

| International application No. | International filing date *(day/month/year)* | (Earliest) Priority date *(day/month/year)* |
|---|---|---|
| PCT/FI00/00657 | 21 July 2000 (21.07.00) | 23 July 1999 (23.07.99) |

Title of invention:
Method and arrangement for determining the operating frequencies of base stations of an internal network

**Box No. II APPLICANT(S)**

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

NOKIA NETWORKS OY
P.O. Box 300, FIN-00045 NOKIA GROUP, Finland

Telephone No.:

Facsimile No.:

Teleprinter No.:

| State *(that is, country)* of nationality: | State *(that is, country)* of residence: |
|---|---|
| Finland | Finland |

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

SUONVIERI, Jukka
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|---|---|
| Finland | Finland |

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PARKKALI, Rauli
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|---|---|
| Finland | Finland |

☐ Further applicants are indicated on a continuation sheet.

**Box No III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**

The following person is [X] agent [ ] common representative

and [X] has been appointed earlier and represents the applicant(s) also for international preliminary examination

[ ] is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked

[ ] is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

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[ ] **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special addr ess to which correspondence should be sent

**Box No IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION**

**Statement concerning amendments:***

1 The applicant wishes the international preliminary examination **to start on the basis of:**

[X] the international application as originally filed

the description
- [X] as originally filed
- [ ] as amended under Article 34

the claims
- [X] as originally filed
- [ ] as amended under Article 19 (together with any accompanying statement)
- [ ] as amended under Article 34

the drawings
- [X] as originally filed
- [ ] as amended under Article 34

2 [ ] The applicant wishes any amendment to the claims under Article 19 to be considered as reversed

3 [ ] The applicant wishes the start of the international preliminary examination **to be postponed** until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69(d)) *(This check-box may be marked only where the time limit under Article 19 has not yet expired)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended

**Language for the purposes of international preliminary examination:** English

- [ ] which is the language in which the international application was filed
- [X] which is the language of a translation furnished for the purposes of international search
- [X] which is the language of publication of the international application
- [ ] which is the language of the translation (to be) furnished for the purposes of international preliminary examination

**Box No V ELECTION OF STATES**

The applicant hereby **elects all eligible States** *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes **not to elect:**

International application No
PCT/FI00/00657

**Box No VI CHECK LIST**

| The demand is accompanied by the following elements, in the language referred to in Box No V, for the purposes of international preliminary examination: | | | For International Preliminary Examining Authority use only: received | not received |
|---|---|---|---|---|
| 1 translation of international application | : | sheets | ☐ | ☐ |
| 2 amendments under Article 34 | : | sheets | ☐ | ☐ |
| 3 copy (or, where required, translation) of amendments under Article 19 | : | sheets | ☐ | ☐ |
| 4 copy (or, where required, translation) of statement under Article 19 | : | sheets | ☐ | ☐ |
| 5 letter | : | sheets | ☐ | ☐ |
| 6 other *(specify)* | : | sheets | ☐ | ☐ |

The demand is also accompanied by the item(s) marked below:

1 ☒ fee calculation sheet

2 ☐ separate signed power of attorney

3 ☐ copy of general power of attorney; reference number, if any:

4 ☐ statement explaining lack of signature

5 ☐ nucleotide and or amino acid sequence listing in computer readable form

6 ☐ other *(specify)*:

**Box No VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE**

*Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand)*

BERGGREN OY AB

Sirpa Kuisma
Patent Attorney

Helsinki, Finland, 20 February 2001

For International Preliminary Examining Authority use only

1 Date of actual receipt of DEMAND:

2 Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3 ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply ☐ The applicant has been informed accordingly

4 ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5

5 ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82

For International Bureau use only

Demand received from IPEA on:

PCT Chapter II
MU DG 2

# PCT

## FEE CALCULATION SHEET

### Annex to the Demand for international preliminary examination

| | |
|---|---|
| International application No. | PCT/FI00/00657 |
| Applicant's or agent's file reference | BP100021/SKU/PKK |

For International Preliminary Examining Authority use only

Date stamp of the IPEA

Applicant

NOKIA NETWORKS OY

**Calculation of prescribed fees**

| | | | |
|---|---|---|---|
| 1. Preliminary examination fee | EUR 1533 | P | |
| 2. Handling fee *(Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.)* | EUR 147 | H | |
| 3. Total of prescribed fees. Add the amounts entered at P and H and enter total in the TOTAL box | EUR 1680 TOTAL | | |

**Mode of Payment**

| | | | |
|---|---|---|---|
| [X] | authorization to charge deposit account with the IPEA (see below) | [ ] | cash |
| [ ] | cheque | [ ] | revenue stamps |
| [ ] | postal money order | [ ] | coupons |
| [ ] | bank draft | [ ] | other *(specify)*: |

**Deposit Account Authorization** *(this mode of payment may not be available at all IPEAs)*

The IPEA/ EP [X] is hereby authorized to charge the total fees indicated above to my deposit account.

[ ] *(this check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)* is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

Berggren Oy Ab

| 28150004 | 20 Februarv 2001 | Pia Kulju, Patent Assistant |
|---|---|---|
| Deposit Account Number | Date *(day/month/year)* | Signature |

RECORD COPY



**PCT REQUEST**

BP100021

Original (for **SUBMISSION**) - printed on 21.07.2000 11:29:01 AM

| | | |
|---|---|---|
| 0<br>0-1 | **For receiving Office use only**<br>International Application No. - | PCT/FI 0 0 / 0 0 6 5 7 |
| 0-2 | International Filing Date | 21 JUL 2000 (21-07-2000) |
| 0-3 | Name of receiving Office and "PCT International Application" | The Finnish Patent Office<br>PCT International Application |
| 0-4<br>0-4-1 | **Form - PCT/RO/101 PCT Request**<br>Prepared using | PCT-EASY Version 2.90<br>(updated 10.05.2000) |
| 0-5 | **Petition**<br>The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty | |
| 0-6 | **Receiving Office (specified by the applicant)** | National Board of Patents and Registration (Finland) (RO/FI) |
| 0-7 | **Applicant's or agent's file reference** | BP100021 |
| I | **Title of Invention** | A METHOD AND A SYSTEM FOR DETERMINING OPERATING FREQUENCIES OF BASE STATIONS OF AN INTERNAL NETWORK |
| II | **Applicant** | |
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| II-2 | Applicant for | all designated States except US |
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| III-1-7 | State of residence | FI |

**PCT REQUEST**

BP100021

Original (for **SUBMISSION**) - printed on 21.07.2000 11:29:01 AM

| | | |
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| IV-1-5 | e-mail | email.box@berggren.fi |
| **V** | **Designation of States** | |
| V-1 | Regional Patent<br>(other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned) | AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT<br>EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT<br>EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT<br>OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT |
| V-2 | National Patent<br>(other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned) | AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH&LI CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW |

**PCT REQUEST**

BP100021

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| | | | |
|---|---|---|---|
| **V-5** | **Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. | | |
| **V-6** | **Exclusion(s) from precautionary designations** | **NONE** | |
| **VI-1** | **Priority claim of earlier national application** | | |
| VI-1-1 | Filing date | **23 July 1999 (23.07.1999)** | |
| VI-1-2 | Number | **991643** | |
| VI-1-3 | Country | **FI** | |
| **VI-2** | **Priority document request** The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s): | **VI-1** | |
| **VII-1** | **International Searching Authority Chosen** | **Swedish Patent Office (ISA/SE)** | |
| **VIII** | **Check list** | number of sheets | electronic file(s) attached |
| VIII-1 | Request | **4** | - |
| VIII-2 | Description | **8** | - |
| VIII-3 | Claims | **3** | - |
| VIII-4 | Abstract | **1** | **100021.txt** |
| VIII-5 | Drawings | **4** | - |
| VIII-7 | TOTAL | **20** | |
| | **Accompanying Items** | paper document(s) attached | electronic file(s) attached |
| VIII-8 | Fee calculation sheet | ✓ | - |
| VIII-10 | Copy of general power of attorney | ✓ | - |
| VIII-16 | PCT-EASY diskette | - | **diskette** |
| **VIII-18** | **Figure of the drawings which should accompany the abstract** | **1A** | |
| **VIII-19** | **Language of filing of the international application** | **Finnish** | |
| **IX-1** | **Signature of applicant or agent** |  | |
| IX-1-1 | Name | **BERGGREN OY AB** | |
| IX-1-2 | Name of signatory | **Markus Levlin** | |
| IX-1-3 | Capacity | **Patent Attorney** | |

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## FOR RECEIVING OFFICE USE ONLY

| | | |
|---|---|---|
| 10-1 | **Date of actual receipt of the purported international application** | 21 JUL 2000 ( 21-07-2000 ) |
| 10-2 | **Drawings:** | |
| 10-2-1 | Received | |
| 10-2-2 | Not received | |
| 10-3 | **Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application** | |
| 10-4 | **Date of timely receipt of the required corrections under PCT Article 11(2)** | |
| 10-5 | **International Searching Authority** | ISA/SE |
| 10-6 | **Transmittal of search copy delayed until search fee is paid** | |

## FOR INTERNATIONAL BUREAU USE ONLY

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|---|---|---|
| 11-1 | **Date of receipt of the record copy by the International Bureau** | 18 AUGUST 2000 ( 18.08.00 |

# PCT (ANNEX - FEE CALCULATION SHEET)

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(This sheet is not part of and does not count as a sheet of the international application)

| | | |
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| **0**<br>0-1 | **For receiving Office use only**<br>International Application No. | |
| 0-2 | Date stamp of the receiving Office | |

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|---|---|---|---|---|---|
| 0-4<br>0-4-1 | **Form - PCT/RO/101 (Annex)**<br>**PCT Fee Calculation Sheet**<br>Prepared using | | PCT-EASY Version 2.90 (updated 10.05.2000) | | |
| 0-9 | **Applicant's or agent's file reference** | | BP100021 | | |
| 2 | **Applicant** | | NOKIA NETWORKS OY, et al. | | |
| 12 | **Calculation of prescribed fees** | | fee amount/multiplier | total amounts (FIM) | |
| 12-1 | Transmittal fee | T | ⇨ | 800 | |
| 12-2 | Search fee | S | ⇨ | 5 618 | |
| 12-3 | International fee<br>Basic fee<br>(first 30 sheets) | b1 | 2 431,8 | | |
| 12-4 | Remaining sheets | | 0 | | |
| 12-5 | Additional amount | (X) | 53,51 | | |
| 12-6 | Total additional amount | b2 | 0 | | |
| 12-7 | b1 + b2 = | B | 2 431,8 | | |
| 12-8 | Designation fees<br>Number of designations contained in international application | | 87 | | |
| 12-9 | Number of designation fees payable (maximum 8) | | 8 | | |
| 12-10 | Amount of designation fee | (X) | 523,22 | | |
| 12-11 | Total designation fees | D | 4 185,76 | | |
| 12-12 | PCT-EASY fee reduction | R | -749,16 | | |
| 12-13 | Total International fee (B+D-R) | I | ⇨ | 5 868,4 | |
| 12-14 | Fee for priority document<br>Number of priority documents requested | | 1 | | |
| 12-15 | Fee per document | (X) | 422 | | |
| 12-16 | Total priority document fee | P | ⇨ | 422 | |
| 12-17 | **TOTAL FEES PAYABLE (T+S+I+P)** | | ⇨ | 12 708,4 | |
| 12-19 | **Mode of payment** | | cheque | | |

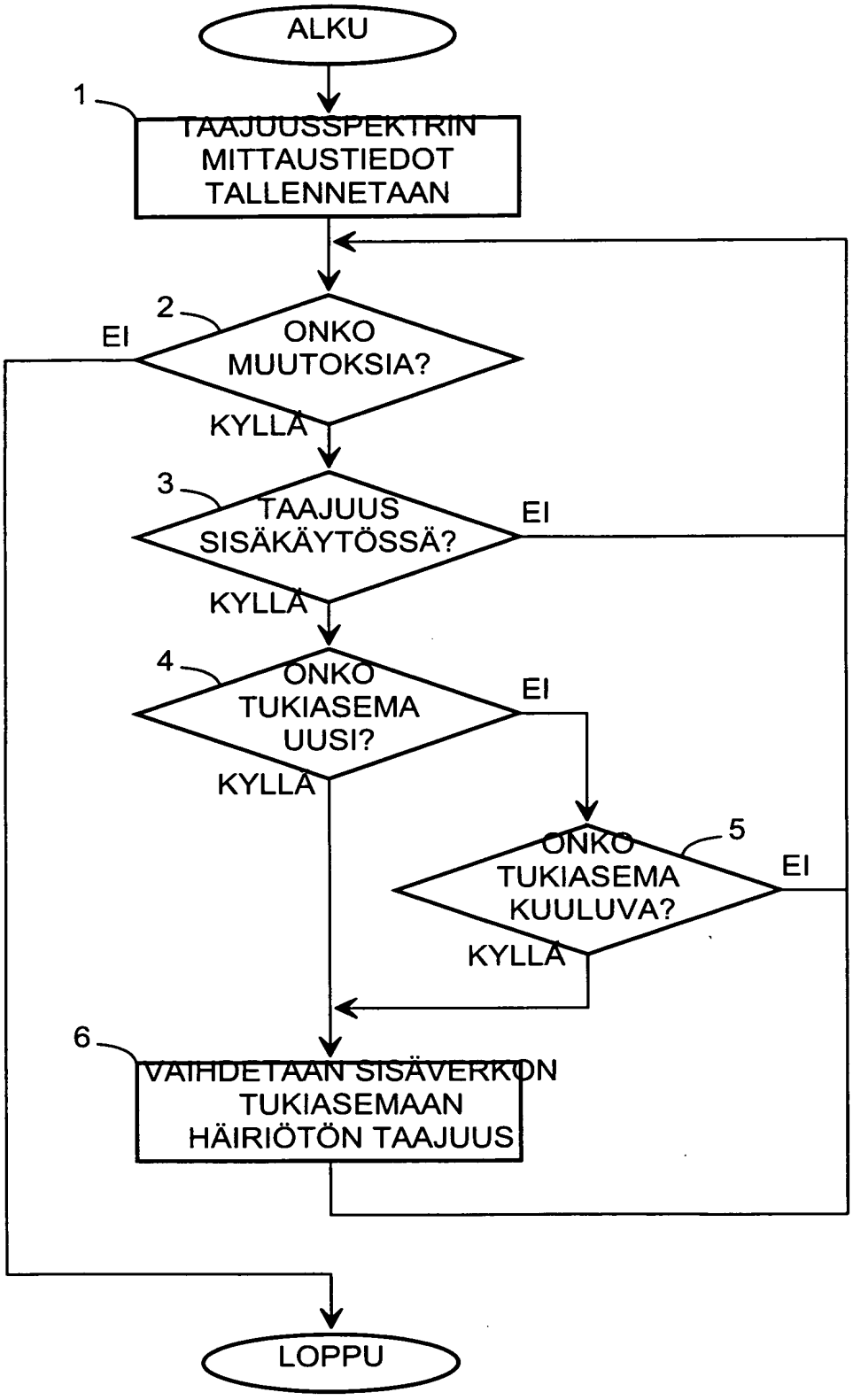
## VALIDATION LOG AND REMARKS

| | | |
|---|---|---|
| 13-2-1 | **Validation messages**<br>**Request** | Green?<br>A translation of the international application into English will have to be prepared under the responsibility of the ISA selected. |

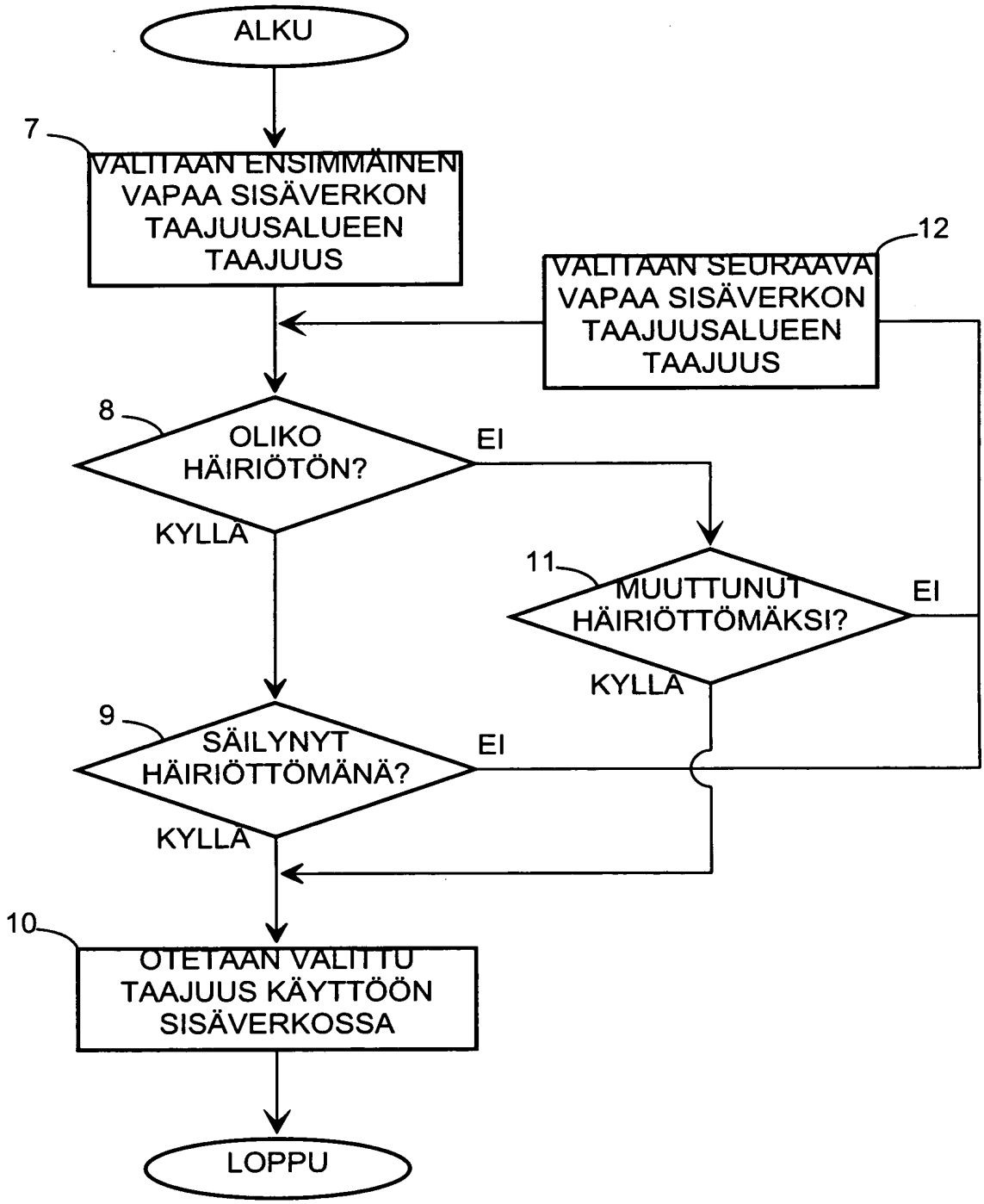
**PCT (ANNEX - FEE CALCULATION SHEET)** BP100021

Original (for **SUBMISSION**) - printed on 21.07.2000 11:29:01 AM

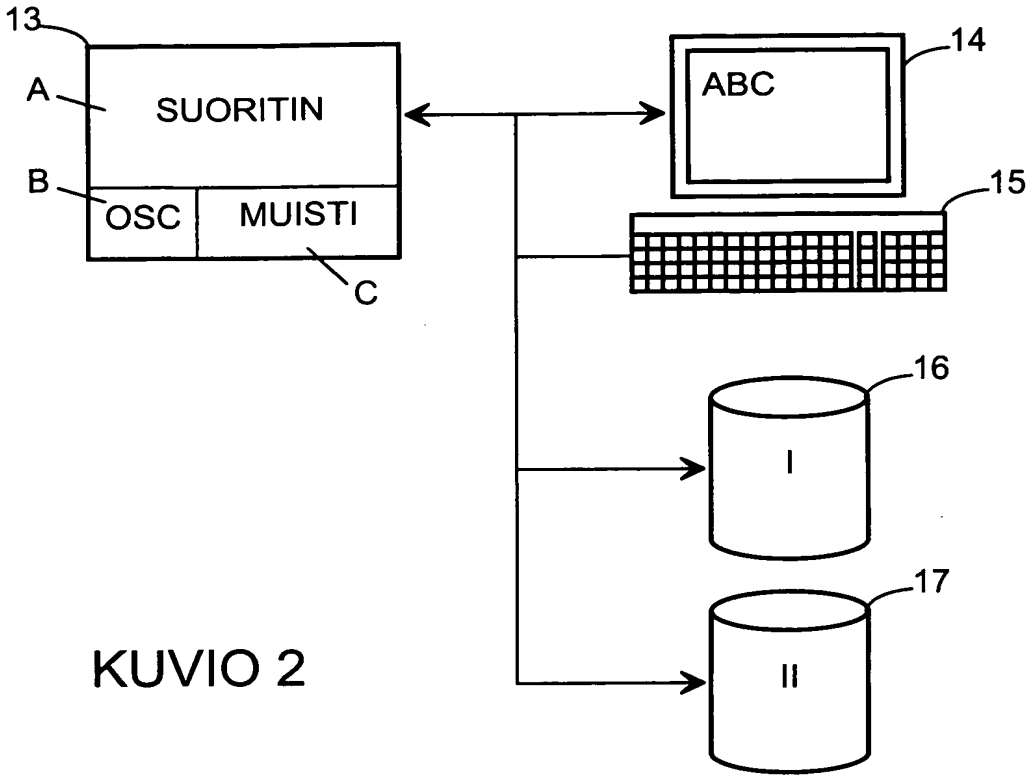
| | | |
|---|---|---|
| | | Green?<br>Please note that the entire request (including the title of invention) must be in English |
| 13-2-6 | Validation messages<br>Contents | Green?<br>Reference number for attached copy of general power of attorney not indicated. |


ALKU
1
TAAJUUSSPEKTRIN MITTAUSTIEDOT TALLENNETAAN
2
ONKO MUUTOKSIA?
EI
KYLLÄ
3
TAAJUUS SISÄKÄYTÖSSÄ?
EI
KYLLÄ
4
ONKO TUKIASEMA UUSI?
EI
KYLLÄ
5
ONKO TUKIASEMA KUULUVA?
EI
KYLLÄ
6
VAIHDETAAN SISÄVERKON TUKIASEMAAN HÄIRIÖTÖN TAAJUUS
LOPPU

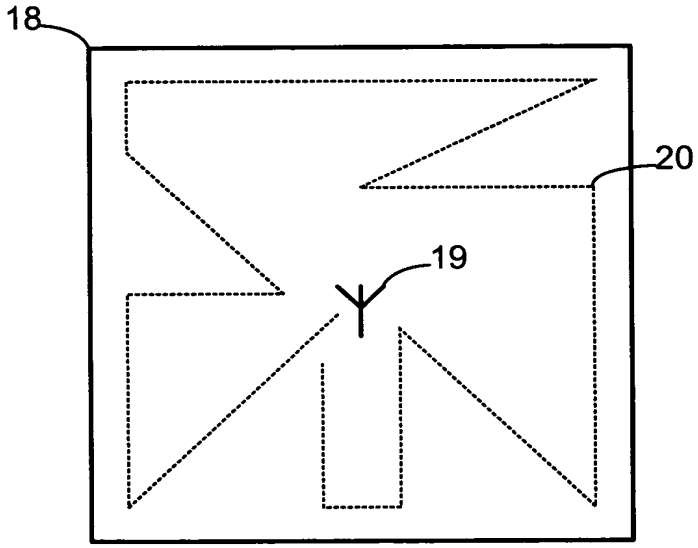
KUVIO 1A


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VALITAAN ENSIMMÄINEN VAPAA SISÄVERKON TAAJUUSALUEEN TAAJUUS
12
VALITAAN SEURAAVA VAPAA SISÄVERKON TAAJUUSALUEEN TAAJUUS
8
OLIKO HÄIRIÖTÖN?
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KYLLÄ
11
MUUTTUNUT HÄIRIÖTTÖMÄKSI?
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KYLLÄ
9
SÄILYNYT HÄIRIÖTTÖMÄNÄ?
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OTETAAN VALITTU TAAJUUS KÄYTTÖÖN SISÄVERKOSSA
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KUVIO 1B



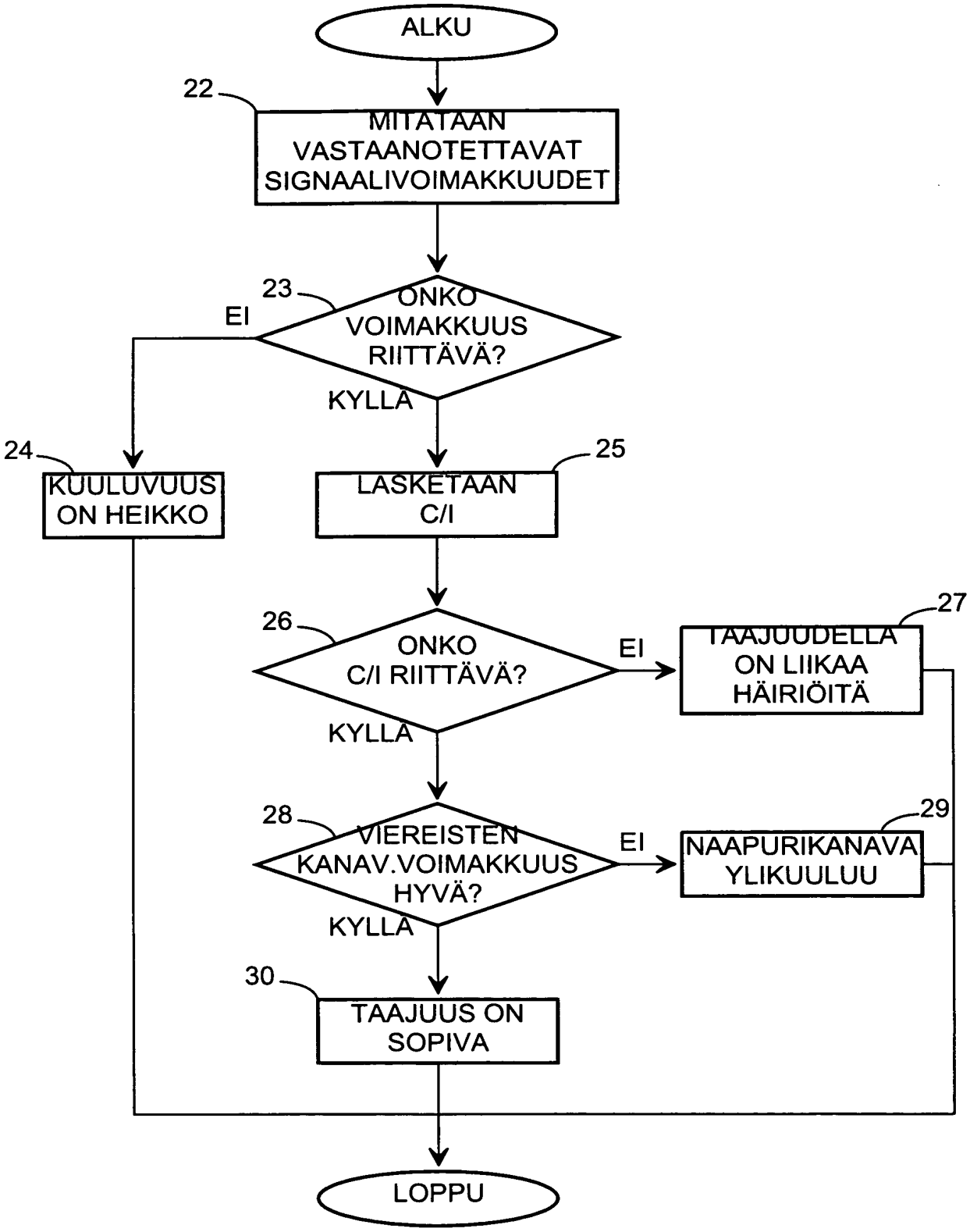

KUVIO 2




KUVIO 3




KUVIO 4


ALKU
22
MITATAAN VASTAANOTETTAVAT SIGNAALIVOIMAKKUUDET
23
ONKO VOIMAKKUUS RIITTÄVÄ?
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24
KUULUVUUS ON HEIKKO
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LASKETAAN C/I
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TAAJUUDELLA ON LIIKAA HÄIRIÖITÄ
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VIEREISTEN KANAV.VOIMAKKUUS HYVÄ?
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NAAPURIKANAVA YLIKUULUU
KYLLÄ
30
TAAJUUS ON SOPIVA
LOPPU

KUVIO 5

# Menetelmä ja järjestely sisäverkon tukiasemien toimintataajuuksien määrittämiseksi

Keksinnön kohteena on sisätiloihin asennettujen solukkoradioverkon tukiasemien toimintataajuuksien uudelleenmäärittäminen, kun sisäverkon toimintaedellytykset ovat muuttuneet aikaisemmasta tilanteesta.

Sisäverkolla tarkoitetaan tässä sisätiloihin tai muuten rajoitetulle alueelle toteutettua solukkoradioverkkoa tai solukkoradioverkon osaa. Ulkoverkolla tarkoitetaan tässä sisäverkon alueella havaittavaa toista solukkoradioverkkoa tai solukkoradioverkon osaa.

Eräs ongelma tunnetuissa ratkaisuissa on mittauksen uusimistarve ympäristön tukiasemien toimintataajuuksien muutoksen jälkeen. Muutos aiheuttaa sisäverkon kannalta häiriötaajuuksien vaihtumisen, mikä voi aiheuttaa sisäverkon yhteyksien laadun huonontumista.

Edelleen ongelmana tunnetuissa ratkaisuissa on mitattavan taajuuskaistan laajuudesta johtuva tarve suuren kapasiteetin omaavasta mittauslaitteesta riittävän nopean ja tarkan taajuuspyyhkäisyn suorittamiseksi.

Keksinnön tarkoituksena on esittää uusi tunnettua edullisempi ratkaisu sisäverkon tukiasemien toimintataajuuksien määrittämiseksi sekä menetelmä, joka mahdollistaa sisäverkon taajuuksien uudelleenmäärityksen ilman uutta häiriötason kartoitusmittausta.

Keksintö koskee menetelmää sisäverkon tukiasemien toimintataajuuksien uudelleenmäärittämiseksi, kun sisäverkon toimintaedellytykset ovat muuttuneet. Keksinnön mukaisesti toimintataajuuksien uudelleenmäärittäminen suoritetaan aikaisempaa määrittelyä varten tietyllä mittausreitillä suoritetun taajuusmittauksen ja ulkoverkon tietojen perusteella.

Sisäverkon toimintaedellytysten muuttumisella tarkoitetaan tässä ainakin ulkoverkon tukiasemien lisäystä tai vähennystä, toimintataajuuksien ja/tai lähetystehojen muuttamista ja ulkoisista olosuhteista johtuvaa muutosta radioaaltojen etenemisessä.

Keksintö koskee myös järjestelyä sisäverkon tukiasemien taajuusmittauksella aikaisemmin määriteltyjen toimintataajuuksien määrittämiseksi uudelleen, kun

sisäverkon toimintaedellytykset ovat muuttuneet. Keksinnön mukaisesti siihen kuuluu tietojenkäsittelyvälineet toimintataajuuksien määrittämiseksi uudelleen aikaisempaa määrittelyä varten tietyllä mittausreitillä suoritetun taajuusmittauksen ja ulkoverkon tietojen perusteella.

Taajuusmittauksessa käytetään edullisesti saman hakijan salaisen patenttihakemuksen FI 981491 (Tukiaseman konfigurointimenetelmä) mukaista erityisen taajuushäiriöitä mittaavaa laitetta sopivien taajuuksien löytämiseksi rakennuksen sisällä. Laitteella mitataan häiriötason voimakkuutta solukkoverkon käyttämillä taajuuksilla. Laitetta kuljetetaan rakennuksessa halutulla sisäverkon alueella vapaiden taajuuksien löytämiseksi. Tukiasemille kartoitetaan mittauksen perusteella toimintataajuudet, joiden häiriötaso on vaadittua kentänvoimakkuutta alempi.

Häiriötaajuusspektri mitataan kerran sisäverkon alueella kuten esimerkiksi rakennuksen, tehdasalueen tms. sisällä ulkoverkon radiolähetyksen sisäverkolle aiheuttamien taajuusrajoitteiden löytämiseksi. Mittaustiedot siirretään mittauslaitteesta edullisimmin datapuhelulla verkonvalvontajärjestelmään (NMS, Network Management System). Mittauslaite on tällöin edullisimmin erityinen mittauskäyttöön mukautettu matkaviestin. Sisäverkon tukiasemien taajuudet valitaan aluksi mittauksen perusteella. Ulkoverkko voi myöhemmin alkaa häiritä sisäverkkoa voimakkaasti, jos sisäverkon lähellä otetaan ulkoverkon tukiasemassa käyttöön jo sisäverkossa käytössä oleva taajuus. Keksinnön mukaisesti käytetään alkuperäistä mittausta ja ulkoverkon taajuussuunnitelmia sisäverkon taajuuksien uudessa suunnittelussa. Täten ei tarvita uutta mittauskäyntiä sisäverkon alueella.

Menetelmä toimii erityisen hyvin, mikäli mittauksen aikana on voitu mitata ja tallentaa sisäverkon alueella kuuluvien ulkosolujen radiolähetysten solutiedot. Mikäli mittauksessa havaitulle ulkoverkon solulle annetaan jokin sisäverkon käytössä olevista taajuuksista, tiedetään varmasti, että sisäverkon tukiaseman taajuus on vaihdettava.

Sisäverkon käyttöön valitut taajuudet ovat lisäksi valinnan jälkeen tarkastettavissa vastaanottotason ja häiriösuhteen mittauksella. Tämä suoritetaan edullisimmin keksinnön mukaisella mittauslaitteella.

Keksinnön edullisia suoritusmuotoja on esitetty epäitsenäisissä patenttivaatimuksissa.

Seuraavassa keksintöä selostetaan yksityiskohtaisesti viittaamalla oheiseen piirustukseen, jossa

kuvio 1 esittää vuokaaviota keksinnön erään edullisen toteutusmuodon mukaisesta menetelmästä sisäverkon toimintataajuuksien valitsemiseksi,

kuvio 2 esittää lohkokaaviota keksinnön erään edullisen toteutusmuodon mukaisesta järjestelystä,

kuvio 3 esittää esimerkkiä mittausreitistä häiriötaajuuksien mittaamiseksi,

kuvio 4 esittää keksinnön erään edullisen toteutusmuodon mukaista mittaustulosten tallennusmuotoa, ja

kuvio 5 esittää vuokaaviota keksinnön erään edullisen toteutusmuodon mukaisesta menetelmästä sisäverkon sopivimpien toimintataajuuksien etsimiseksi.

Kuvioissa 1A ja 1B esitetään jaettu vuokaavio eräästä keksinnön mukaisesta menetelmästä aikaisemmin määriteltyjen sisäverkon toimintataajuuksien muuttamiseksi ulkoverkon tukiasemien toimintataajuuksien ja aikaisemman mittaustiedon perusteella.

Kuviosta 1A nähdään seuraavaa. Verkonvalvontajärjestelmässä tallennetaan aikaisemman mittauksen tulokset häiriötaajuusspektristä edullisesti sisäverkon tukiasemien mukaan ryhmiteltyinä 1.

Tutkitaan verkonvalvontajärjestelmällä, onko ulkoverkossa muutoksia 2, joita ei ole käsitelty sisäverkon suhteen. Jos käsittelemättömiä muutoksia on, tutkitaan, onko ulkoverkossa otettu käyttöön sisäverkossa käytettävä taajuus 3. Jos ulkoverkon tukiasemassa käyttöönotettu taajuus ei ole käytössä sisäverkossa, palataan vaiheeseen 2 tutkimaan, onko käsittelemättömiä ulkoverkon muutoksia jäljellä. Vastaavasti, jos vaiheessa 3 selviää, että ulkoverkon tukiasemassa käyttöönotettu taajuus on käytössä sisäverkossa, siirrytään tutkimaan, onko muutoksen kohteena oleva tukiasema nyt asennettu uusi tukiasema 4, jota ei siis ole aikaisemmin ollut ympäröivässä solukkoradioverkossa. Jos tukiasema on uusi ja mahdollisesti häiritsevällä etäisyydellä, mikä on todettavissa radioverkon suunnittelua tehtäessä, vaihdetaan varmuuden vuoksi siihen sisäverkon tukiasemaan, jonka sisäverkon tukiaseman taajuutta uusi ulkoverkon tukiasema käyttää, aikaisemman mittauksen ja ulkoverkon muutosten perusteella häiriötön taajuus 6. Jos ulkoverkon tukiasema ei

ole uusi ja on sisäverkkoa aikaisemman mittauksen tulosten perusteella häiritsevä 5, vaihdetaan siihen sisäverkon tukiasemaan aikaisemman mittauksen ja ulkoverkon muutosten perusteella häiriötön taajuus 6, jonka taajuutta ulkoverkon tukiasema käyttää. Jos ulkoverkon tukiasema ei ole uusi eikä ole kuulunut ennen, palataan vaiheeseen 2 tutkimaan, onko käsittelemättömiä ulkoverkon muutoksia jäljellä. Jos käsittelemättömiä ulkoverkon muutoksia 2 ei ole jäljellä, lopetetaan. Alan ammattimiehelle on selvää, että edellä kuvatun menetelmän vaiheissa 3-5 tutkitaan yleisesti, onko ulkoverkossa otettu käyttöön sisäverkon tukiasemaa käyttävä taajuus, minkä seurauksena tarvittaessa vaihdetaan kyseiseen sisäverkon tukiasemaan aikaisemman mittauksen ja ulkoverkon taajuuksien perusteella häiriötön taajuus.

Kuviosta 1B nähdään, kuinka aikaisemman mittauksen ja ulkoverkon muutosten perusteella valitaan häiriötön taajuus eli taajuus, joka alunperin oli häiriötön ja jota ei ole jouduttu ulkoverkon taajuusmuutosten vuoksi hylkäämään sisäverkossa häiriöllisenä. Ensin valitaan sisäverkolle varatulta taajuusalueelta ensimmäinen taajuus 7, joka ei ole sisäverkon sellaisen tukiaseman käytössä, joka voisi aiheuttaa häiriötä sille tukiasemalle, jolla uutta häiriötöntä taajuutta ollaan valitsemassa. Seuraavaksi tutkitaan, onko taajuus häiriötön aikaisemmin suoritetun mittauksen perusteella 2. Jos taajuus on mittauksen perusteella häiriötön, tutkitaan, onko taajuus säilynyt ulkoverkon muutoksista häiriöttömänä 9, ja jos on, otetaan valittu taajuus käyttöön 10. Ellei taajuus ollut mittauksessa häiriötön, voidaan tutkia, onko taajuus muuttunut ulkoverkon muutoksista häiriöttömäksi 11, ja ottaa käyttöön 10. Ellei aikaisemmin häiriötön taajuus ole säilynyt häiriöttömänä tai aikaisemmin häiriöllinen taajuus ei ole muuttunut häiriöttömäksi, valitaan sisäverkon taajuusalueelta seuraava taajuus 12, joka ei ole sisäverkon sellaisen tukiaseman käytössä, joka voisi aiheuttaa häiriötä sille tukiasemalle, jolla uutta häiriötöntä taajuutta ollaan valitsemassa.

Kuviossa 2 esitetään lohkokaavio eräästä keksinnön mukaisesta järjestelystä sisäverkon tukiasemien taajuusmittauksella aikaisemmin määriteltyjen toimintataajuuksien määrittämiseksi uudelleen, kun ulkoverkon tukiasemien toimintataajuutta on muutettu. Järjestelyyn kuuluu suoritinyksikkö 13, johon sisältyy ainakin prosessori A, värähtelijä B prosessorin askeltamiseksi ja muisti C, näyttölaite 14, tiedonsyöttölaite, kuten näppäimistö 15, ensimmäinen tietokanta 16 aikaisemmin suoritetun mittauksen tietojen tallennusta varten ja toinen tietokanta 17 ulkoverkon tukiasemien toimintataajuuksien tallennusta varten. Suorittimella 13 määritellään syöttötietojen, kuten näppäimistöllä 15 annettavien komentojen, ensimmäisen tietokannan 16 tietojen ja toisen tietokannan 17 tietojen perusteella

sisäverkon tukiasemien uudet toimintataajuudet esimerkiksi kuvioiden 1A, 1B vuokaavioiden mukaisella tavalla.

Tietokannat 16, 17 ovat tallennettavissa myös erilliseen muistielimeen, kuten matkaviestinverkon hallintajärjestelmän tietokantaan. Kuviossa 2 esitetyt toiminnalliset lohkot 13, 14, 15, 16, 17 ovat sijoitettavissa vaihtoehtoisesti yhteen tai useaan erilliseen tietokonelaitteeseen. Sopivia tietokonelaitteita ovat esimerkiksi kannettava tietokone ja monitoiminen matkaviestin.

Kuviossa 3 esitetään kartta eräästä mittausreitistä häiriötasojen mittaamiseksi sisätiloissa. Huonetilassa 18 sijaitsee sisäverkon tukiasema 19. Mittaus suoritetaan kiertämällä tukiasema 19 huonetilassa 18 esimerkiksi murtoviivan 20 mukaista reittiä, jolloin käydään huonetilan 18 nurkissa ja välillä lähellä tukiasemaa 19 mahdollisimman kattavan häiriömittauksen suorittamiseksi.

Kuviossa 4 esitetään esimerkinomaisesti eräs mittaustulosten tallennusmuoto, joka sisältää seuraavat tiedot: taajuus ja häiriötaso sekä mikäli mahdollista radiolähetyksen tuottavan ulkoverkon tukiaseman tunnistuskoodi (BSIC Base Station Identification Code) ja tunnus (BTS_ID Base Transceiver Station Identification). Tukiaseman tunnistuskoodi koostuu tyypillisesti yleisen matkaviestinverkon ja tukiaseman värikoodeista. Tukiaseman tunnus koostuu tyypillisesti seuraavista osista: matkaviestinnän maatunnus (MCC Mobile Country Code), matkaviestinverkon tunnus (MNC Mobile Network Code), sijaintialueen koodi (LAC Location Area Code) ja tukiaseman koodi (Base station code).

Kuviossa 5 esitetään vuokaavio eräästä keksinnön mukaisesta menetelmästä sisäverkon sopivimpien toimintataajuuksien etsimiseksi yhden tutkittavan taajuuden osalta. Vaiheessa 22 mitataan vastaanotettavat signaalivoimakkuudet (Rx Level) sisäverkon tukiaseman lähettäessä signaalia koetta varten valitulla yleislähetyskanavalla (BCCH Broadcast Control Channel) esimerkiksi samalla mittausreitillä kuin edellä kuviossa 3. Mittaus suoritetaan sekä koetta varten valitulla yleislähetyskanavalla että kaikilla vertailtavilla taajuuksilla. Täten saadaan tieto yleislähetyskanavan lähetyksen kuulumisesta sisäverkon alueella ja häiriöiden kuulumisesta vertailtavilla taajuuksilla. Yleislähetyskanavan signaalivoimakkuuden mittausnäytteistä 90 %:n täytyy olla ennalta asetettua minimiarvoa korkeampia, vaihe 23. Tämä minimiarvo on edullisimmin -77 dBm. Koska radioaaltojen eteneminen järjestelmässä käytettävillä taajuuksilla on käytännöllisesti katsoen sama, on valitulle taajuudelle suoritettu signaalivoimakkuuden mittaus pätevä myös muilla mahdollisilla toimintataajuuksilla. Mahdollisella toimintataajuudella

tarkoitetaan tässä aikaisemmin häiriömittauksella kelpaavaksi todettua taajuutta. Ellei signaalivoimakkuuden kriteeri täyty, ei kuuluvuus ole riittävä vaan heikko, vaihe 24.

Signaalivoimakkuuden kriteerin täyttyessä lasketaan lisäksi vaiheessa 25 kantoaalto-häiriösuhde C/I (Carrier/Interference) mittausreitillä kaikille mahdollisille toimintataajuuksille käyttämällä edellä mitattuja yleislähetyskanavan signaalivoimakkuuden näytteitä ja vertailtavilla taajuuksilla suoritettua häiriömittausta. Kantoaalto-häiriösuhteen C/I arvio saadaan tässä jakamalla yleislähetyskanavalla vastaanotettava signaalivoimakkuus vertailtavalla taajuudella vastaanotettavalla signaalivoimakkuudella. Solukkoverkon rakenteesta johtuen kaikilla taajuuksilla on jonkin verran signaalivoimakkuutta, joka vastaanotetaan muualta solukkoverkosta. Yleislähetyskanavalla mittauksen aikana käytettävää taajuutta ei kuitenkaan voida vertailla häiriölähetyksiin samalla kanavalla. Vaiheessa 26 tutkitaan, onko kantoaalto-häiriösuhde kaikilta näytteiltään riittävän hyvä. Kantoaalto-häiriösuhteen näytekohtainen minimiarvo on edullisimmin 12 dB. Jos kriteeri ei täyty, on taajuudella liikaa häiriöitä, vaihe 27.

Tämän lisäksi kanavan sopivuuden arviointiin käytetään vierekkäisten kanavien voimakkuuden mittausta siten, että edellä mitatun kantoaalto-häiriösuhteen 12 dB:n rajan täyttymisen lisäksi mitataan kaikkia näytteitä varten myös vierekkäisten kanavien voimakkuus. Voimakkuus ei saa kummallakaan kanavalla ylittää enempää kuin tietyn rajan verran sen yleislähetyskanavan signaalivoimakkuutta, jolla lähetetään signaalia mittausta varten, vaihe 28. Vierekkäisen kanavan sallitaan yleensä olla enintään 9 dB:ä voimakkaampi, sillä tällöin kanavat kyetään erottelemaan lähetyksen ja vastaanoton taajuustarkkuudella. Mikäli vierekkäisellä kanavalla on voimakkaampi radiolähetys, se kuuluu varsinaisella kanavalla kanavaerottelusta huolimatta 29. Kun kaikki edellä tutkitut asiat vaiheissa 23, 26, 28 täyttyvät, on taajuus sopiva 30.

Kaikkien toimenpiteiden lopuksi mittaustiedot tallennetaan erityiseen tiedostoon esimerkiksi seuraavalla tavalla.

| BCCH | BSIC | Häiriösuhderaja C/I | Kuuluvuusraja | 90%-kuuluvuusraja |
|---|---|---|---|---|
| 52 | 2 | 12 dB | -87 dBm | -77 dBm |
| | | | Rajan ylittävä osuus | Rajan ylittävä osuus |
| | | | 100 % | 100 % |

**Taulukko 1**

Taulukosta 1 nähdään lähetykseen käytettävän yleislähetyskanavan (BCCH) numero 52 ja tukiaseman tunnistuskoodi (BSIC) 2, hyväksyttävän kantoaalto-häiriösuhteen (C/I) raja 12 dB, ehdoton kuuluvuusraja -87 dBm, 90 %:lta näytteistä vaadittava kuuluvuusraja -77 dBm sekä seuraavaksi kuuluvuusrajat ylittävät suhteelliset osuudet, tässä 100 %.

| BCCH | BSIC | Keskimääräinen C/I | Hvväksyttäviä näytteitä |
|---|---|---|---|
| 74 | 2 | 3,5 dB | 17,4 % |
| 76 | 2 | 9,1 dB | 34,8 % |
| 68 | 4 | 15,8 dB | 60,9 % |
| 49 | 5 | 17,0 dB | 63,0 % |
| 25 | 2 | 23,7 dB | 76,1 % |
| 65 | 1 | 30,7 dB | 82,6 % |
| 30 | 1 | 30,5 dB | 82,6 % |
| 39 | 6 | 28,9 dB | 84,8 % |
| 72 | 3 | 27,0 dB | 87,0 % |
| 26 | 3 | 34,7 dB | 91,3 % |
| 62 | 5 | 33,2 dB | 95,6 % |
| 35 | 5 | 49,5 dB | 97,8 % |
| 41 | 5 | 40,7 dB | 97,8 % |
| 21 | 5 | 40,7 dB | 100,0 % |
| 51 | 3 | 21,9 dB | 100,0 % |
| 46 | 1 | 34,7 dB | 100,0 % |
| 36 | 5 | 43,5 dB | 100,0 % |

**Taulukko 2**

Taulukosta 2 nähdään kuunneltavan kanavan (BCCH) numero ja tukiaseman tunnistuskoodi (BSIC), keskimääräinen kantoaalto-häiriösuhde (C/I) ja häiriörajan kannalta hyväksyttävä mittauksen näytteiden osuus, jolla C/I > 12 dB.

Taulukkoon voidaan myös lisätä sarake, jossa voidaan esittää vierekkäisten kanavien aiheuttama häiriö kullekin kanavalle. Edullisesti voidaan myös ilmaista se kanava, joka juuri kyseiselle kanavalle aiheuttaa häiriötä.

Taulukkoa käytetään myös toimintataajuuksien sopivuusjärjestyksen selvittämiseen.

Tarkastellaan esimerkkinä tukiaseman lisäämistä ulkoverkkoon ja uuden taajuuden käyttöönottoa lisättävässä uudessa tukiasemassa. Sisäverkkoa varten suoritetaan

ensin taajuusspektrin mittaus, jossa määritetään ainakin häiriötasot taajuusalueen eri taajuuksilla, mutta myös signaalin lähettävän solun tunniste, mikäli tunniste kyetään virheettömästi vastaanottamaan. Myöhemmin ulkoverkkoon lisätään tukiasema ja ladataan uusi taajuussuunnitelma. Vanhaa ja uutta taajuussuunnitelmaa käytetään yhdessä taajuusspektrin mittausinformaation kanssa, jotta havaitaan, onko lähellä sijaitsevan ulkosolun tukiasemassa otettu käyttöön sisäkäytössä oleva taajuus, jolloin sisäverkon tukiasemalle täytyy vaihtaa uusi taajuus. Taajuus valitaan ulkoverkon taajuussuunnitelmien ja ennen muutosta mitatun taajuusspektrin perusteella muodostettavasta taulukosta. Aina ei kuitenkaan voida varmasti tietää, miltä tukiasemalta aiempi häiriö on tullut, varsinkaan jos häiriöitä vastaavien solujen tunnistetietoja ei ole käytettävissä. Todennäköisin tietyn radiolähetyksen tuottava tukiasema on kuitenkin pääteltävissä ulkoverkon kartan perusteella, mikäli tukiasemien sijainnin osoittava kartta on käytettävissä.

Edelleen on huomattava, että sisäverkon alueen taajuusspektrin mittaus on rajoitettavissa sisäverkon käyttämälle taajuusalueelle eikä koko järjestelmän käyttämää taajuusaluetta tarvitse mitata. Tämän ansiosta mittaus nopeutuu. Mittauslaitteena käytetään esimerkiksi erityisellä ohjelmistolla varustettua matkaviestintä.

Tässä yhteydessä tarkoitetaan häiriölähetyksellä ulkoverkon tukiaseman lähettämää radiosignaalia, joka kuuluu havaittavasti sisäverkon alueelle.

Keksintöä ei rajata pelkästään edellä esitettyjä sovellutusesimerkkejä koskevaksi, vaan monet muunnokset ovat mahdollisia pysyttäessä patenttivaatimusten määrittelemän keksinnöllisen ajatuksen piirissä. Erityisesti on huomattava, että keksintö on sovellettavissa myös muissa kuin mainitussa GSM-järjestelmässä. Eräs tällainen toinen järjestelmä on UMTS (Universal Mobile Telecommunications System).

**Patenttivaatimukset**

1. Menetelmä sisäverkon tukiasemien toimintataajuuksien uudelleenmäärittämiseksi, kun sisäverkon toimintaedellytykset ovat muuttuneet, **tunnettu** siitä, että toimintataajuuksien uudelleenmäärittäminen suoritetaan aikaisempaa määrittelyä varten suoritetun taajuusmittauksen ja ulkoverkon tietojen perusteella.

2. Patenttivaatimuksen 1 mukainen menetelmä, **tunnettu** siitä, että siihen kuuluu seuraavia menetelmävaiheita:

- tallennetaan (1) aikaisemman mittauksen tulokset,

- tutkitaan (3-5), onko ulkoverkossa otettu käyttöön sisäverkon tukiasemaa häiritsevä taajuus ja

jos häiritsevä taajuus havaitaan (3-5), vaihdetaan (6) sisäverkon tukiasemaan aikaisemman mittauksen ja ulkoverkon taajuuksien perusteella häiriötön taajuus.

3. Patenttivaatimuksen 1 mukainen menetelmä, **tunnettu** siitä, että aikaisemman mittauksen tuloksista tallennetaan (1) sisäverkon tukiasemia kohden ainakin taajuus ja häiriötaso sekä häiriölähetyksen tuottavan ulkoverkon tukiaseman tunnistustiedot.

4. Patenttivaatimuksen 1 mukainen menetelmä, **tunnettu** siitä, että havaittaessa aikaisemman mittauksen perusteella tunnistetun tukiaseman saavan (9) uuden taajuussuunnitelman perusteella jo sisäverkon tukiasemassa käytössä olevan taajuuden vaihdetaan (6) sisäverkon tukiaseman taajuus häiriöttömään taajuuteen.

5. Patenttivaatimuksen 1 mukainen menetelmä, **tunnettu** siitä, että havaittaessa aikaisemman mittauksen perusteella tunnistetun tukiaseman saavan (9) uuden taajuussuunnitelman perusteella sisäverkon tukiaseman käytössä olevaa taajuutta häiritsevän taajuuden vaihdetaan (6) sisäverkon tukiaseman taajuus häiriöttömään taajuuteen.

6. Patenttivaatimuksen 1 mukainen menetelmä, **tunnettu** siitä, että havaittaessa (11) taajuussuunnitelmasta, että aikaisemmalla mittauksella häiriölliseksi havaittu ulkoverkon käytössä ollut taajuus on muuttunut häiriöttömäksi käytöstä poiston ansiosta, otetaan tämä taajuus sisäverkon käyttöön.

7. Patenttivaatimuksen 1 mukainen menetelmä, **tunnettu** siitä, että siihen lisäksi kuuluu seuraavia menetelmävaiheita käyttöön otettavan taajuuden sopivuuden tarkistamiseksi:

- mitataan (22) mittausreitillä sisäverkon alueella vastaanotettava signaalivoimakkuus (Rx Level) sisäverkon tukiaseman lähettäessä signaalia yleislähetyskanavalla (BCCH),

- tutkitaan (23), onko signaalivoimakkuuden mittausnäytteistä tietty ennalta määrätty osuus ennalta asetettua minimiarvoa korkeampi.

8. Patenttivaatimuksen 7 mukainen menetelmä, **tunnettu** siitä, että lasketaan (25) häiriösuhde (C/I) käyttämällä mitattuja yleislähetyskanavan (BCCH) signaalivoimakkuuden (Rx Level) näytteitä ja vertailtavilla taajuuksilla suoritettavaa häiriömittausta.

9. Patenttivaatimuksen 8 mukainen menetelmä, **tunnettu** siitä, että

- tutkitaan (26), onko häiriösuhde tiettyä ennalta määrättyä minimiarvoa parempi kaikilta näytteiltään, ja

- hyväksytään (30) taajuus, jos signaalivoimakkuus on riittävä ja häiriösuhde on tiettyä raja-arvoa parempi.

10. Patenttivaatimuksen 7 mukainen menetelmä, **tunnettu** siitä, että lisäksi vierekkäisen kanavan ylikuulumisen estämiseksi suoritetaan mittaus ja tutkiminen (28) taajuuden hyväksymistä (30) varten.

11. Patenttivaatimuksen 10 mukainen menetelmä, **tunnettu** siitä, että kummankin vierekkäisen kanavan voimakkuus on korkeintaan ennalta määrätyn maksimiarvon verran suurempi tarkastettavan kanavan signaalinvoimakkuutta.

12. Järjestely sisäverkon tukiasemien taajuusmittauksella aikaisemmin määriteltyjen toimintataajuuksien määrittämiseksi uudelleen, kun sisäverkon toimintaedellytykset ovat muuttuneet, **tunnettu** siitä, että siihen kuuluu tietojenkäsittelyvälineet (13, 14, 15, 16, 17) toimintataajuuksien määrittämiseksi uudelleen aikaisempaa määrittelyä varten suoritetun taajuusmittauksen ja ulkoverkon tietojen perusteella.

13. Patenttivaatimuksen 12 mukainen järjestely, **tunnettu** siitä, että siihen kuuluu

- ensimmäinen tietokanta (16) aikaisemmin suoritetun mittauksen tietojen tallennusta varten,

- toinen tietokanta (17) ulkoverkon tukiasemien toimintataajuuksien tallennusta varten, ja

- suoritin (13) ensimmäisen tietokannan tietojen ja toisen tietokannan tietojen perusteella suoritettavaa sisäverkon tukiasemien toimintataajuuksien uudelleenmääritystä varten.

14. Patenttivaatimuksen 13 mukainen järjestely, **tunnettu** siitä, että ensimmäinen tietokanta (16) käsittää tietoja aikaisemmin suoritetussa mittauksessa mitatuista taajuuksista ja niillä mitatuista häiriötasoista.

15. Patenttivaatimuksen 14 mukainen järjestely, **tunnettu** siitä, että ainakin yhden mitatun taajuuden tiedot käsittävät kyseisellä taajuudella havaitun ulkoverkon tukiaseman tunnistustietoja.

16. Patenttivaatimuksen 14 mukainen järjestely, **tunnettu** siitä, että ensimmäinen tietokanta (16) käsittää lisäksi seuraavat aikaisemmin mitatut tiedot käyttöön otetun taajuuden sopivuuden tarkistamiseksi:

- vastaanotettava signaalivoimakkuus (Rx Level) sisäverkon tukiaseman lähettäessä signaalia yleislähetyskanavalla (BCCH),

17. Patenttivaatimuksen 16 mukainen järjestely, **tunnettu** siitä, että aikaisemmin tallennetut tiedot käsittävät myös häiriösuhteen (C/I), joka on laskettu käyttämällä yleislähetyskanavalla (BCCH) vastaanotettavan signaalivoimakkuuden (Rx Level) näytteitä ja toisilla taajuuksilla suoritettua häiriömittausta.

**(57) Tiivistelmä**

Keksintö koskee menetelmää ja järjestelyä sisäverkon tukiasemien toimintataajuuksien uudelleenmäärittämiseksi, kun ulkoverkon tukiasemien toimintataajuutta on muutettu. Tämän uuden ratkaisun mukaisesti toimintataajuuksien määrittäminen uudelleen suoritetaan aikaisempaa määrittelyä varten suoritetun taajuusmittauksen ja toimintataajuudeltaan muutettujen tukiasemien tietojen perusteella. Ulkoverkon tukiasemien toimintataajuudet sisältävän taajuussuunnitelman tiedoista päätellään, onko sisäverkossa käytössä oleva taajuus säilynyt häiriöttömänä vai täytyykö taajuutta vaihtaa. Lisäksi uudelleen määritetyt toimintataajuudet tarkastetaan signaalivoimakkuus- ja häiriösuhdemittauksella sekä tarvittaessa järjestetään sopivuusjärjestykseen.

Kuvio 1A